

SERIES NO.

01-92250

JACK MACLEAN
MH 6H-412
X 6597

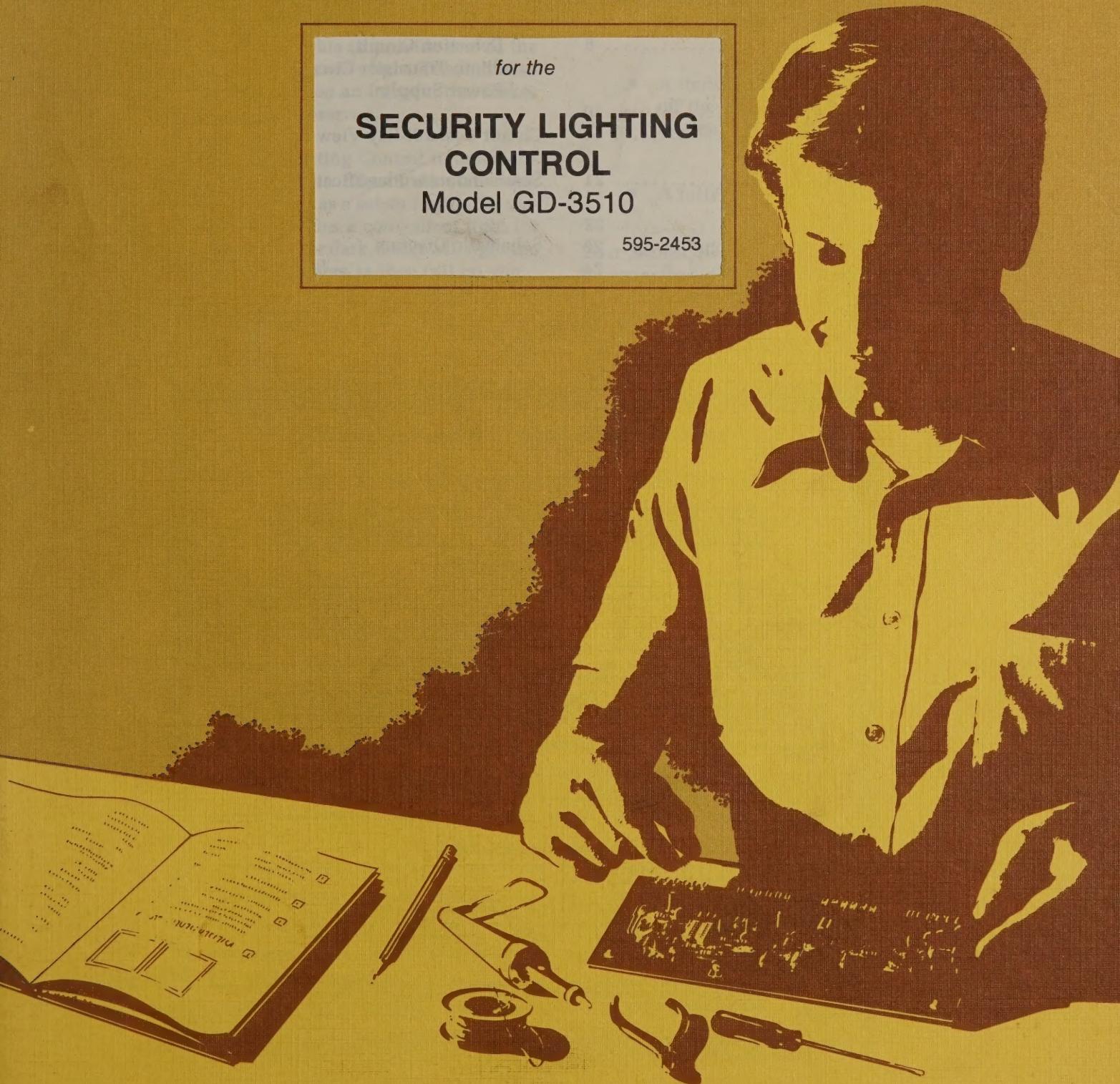
HEATHKIT[®] MANUAL

for the

SECURITY LIGHTING CONTROL

Model GD-3510

595-2453



HEATH COMPANY • BENTON HARBOR, MICHIGAN

HEATH COMPANY PHONE DIRECTORY

The following telephone numbers are direct lines to the departments listed:

Kit orders and delivery information	(616) 982-3411
Credit	(616) 982-3561
Replacement Parts	(616) 982-3571

Technical Assistance Phone Numbers

<i>8:00 A.M. to 12 P.M. and 1:00 P.M. to 4:30 P.M., EST, Weekdays Only</i>	
R/C, Audio, and Electronic Organs	(616) 982-3310
Amateur Radio	(616) 982-3296
Test Equipment, Weather Instruments and	
Home Clocks	(616) 982-3315
Television	(616) 982-3307
Aircraft, Marine, Security, Scanners, Automotive,	
Appliances and General Products	(616) 982-3496
Computers	(616) 982-3309



YOUR HEATHKIT 90-DAY LIMITED WARRANTY

Consumer Protection Plan for Heathkit Consumer Products

Welcome to the Heath family. We believe you will enjoy assembling your kit and will be pleased with its performance. Please read this Consumer Protection Plan carefully. It is a "LIMITED WARRANTY" as defined in the U.S. Consumer Product Warranty and Federal Trade Commission Improvement Act. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

Heath's Responsibility

PARTS — Replacements for factory defective parts will be supplied free for 90 days from date of purchase. Replacement parts are warranted for the remaining portion of the original warranty period. You can obtain warranty parts direct from Heath Company by writing or telephoning us at (616) 982-3571. And we will pay shipping charges to get those parts to you . . . anywhere in the world.

SERVICE LABOR — For a period of 90 days from the date of purchase, any malfunction caused by defective parts or error in design will be corrected at no charge to you. You must deliver the unit at your expense to the Heath factory, any Heathkit Electronic Center (units of Ventechnology Electronics Corporation), or any of our authorized overseas distributors.

TECHNICAL CONSULTATION — You will receive free consultation on any problem you might encounter in the assembly or use of your Heathkit product. Just drop us a line or give us a call. Sorry, we cannot accept collect calls.

NOT COVERED — The correction of assembly errors, adjustments, calibration, and damage due to misuse, abuse, or negligence are not covered by the warranty. Use of corrosive solder and/or the unauthorized modification of the product or of any furnished component will void this warranty in its entirety. This warranty does not include reimbursement for inconvenience, loss of use, customer assembly, set-up time, or unauthorized service.

This warranty covers only Heath products and is not extended to other equipment or components that a customer uses in conjunction with our products.

SUCH REPAIR AND REPLACEMENT SHALL BE THE SOLE REMEDY OF THE CUSTOMER AND THERE SHALL BE NO LIABILITY ON THE PART OF HEATH FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES, INCLUDING BUT NOT LIMITED TO ANY LOSS OF BUSINESS OR PROFITS, WHETHER OR NOT FORSEEABLE.

Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you.

Owner's Responsibility

EFFECTIVE WARRANTY DATE — Warranty begins on the date of first consumer purchase. You must supply a copy of your proof of purchase when you request warranty service or parts.

ASSEMBLY — Before seeking warranty service, you should complete the assembly by carefully following the manual instructions. Heathkit service agencies cannot complete assembly and adjustments that are customer's responsibility.

ACCESSORY EQUIPMENT — Performance malfunctions involving other non-Heath accessory equipment, (antennas, audio components, computer peripherals and software, etc.) are not covered by this warranty and are the owner's responsibility.

SHIPPING UNITS — Follow the packing instructions published in the assembly manuals. Damage due to inadequate packing cannot be repaired under warranty.

If you are not satisfied with our service (warranty or otherwise) or our products, write directly to our Director of Customer Service, Heath Company, Benton Harbor MI 49022. He will make certain your problems receive immediate, personal attention.

Heathkit® Manual

for the

SECURITY LIGHTING CONTROL

Model GD-3510

595-2453

SERIES NO

01-42250

U1
230-3426
LM346N

HEATH COMPANY
BENTON HARBOR, MICHIGAN 49022

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INTRODUCTION

The Heathkit Security Lighting Control, Model GD-3510, is a passive, infrared, heat and motion sensor that can turn on up to 500 watts of peripheral lighting any time it detects a source of heat and motion within its coverage area. You have the assurance that (for example), if an intruder enters its zone of coverage, it will activate your yard lights to provide one of the best known deterrents to crime — light. The light also has a psychological effect on an intruder that makes him believe he is being observed.

You can also use the Lighting Control to automatically provide switching to illuminate stairways, walkways, and driveways, as a safety feature for visitors. In addition, it provides a convenient light for you as you return home after dark, and it will light the way for friends and neighbors as they call on you.

Some of its many features include:

- All-weather design to provide satisfactory operation in outdoor conditions.

- A photo transistor that deactivates the system during daylight hours.
- A typical area coverage of 625 square feet per unit.
- A timing circuit which automatically turns off the lighting four minutes after the last motion is sensed in its coverage area.
- A fully adjustable coverage pattern.

Your Security Lighting Control is an instrument that incorporates the latest state-of-the-art design techniques. Housed in a rugged, molded plastic cabinet, its neutral coloring will easily blend with its background. This economical, compact Security Lighting Control will give you many years of safety and service.

ASSEMBLY

1. Follow instructions carefully. Read the Assembly Manual before you begin, and remember to do the following:
 1. The diagram in the Manual is called the "Exploded View" and shows you how to assemble the various parts. Generally, the parts are held together by small metal pins. When you are instructed to refer to another Manual, "See Manual", follow the steps, and then return to the Manual you are referred to another Manual for further assembly steps.

UNPACKING

When you opened your shipping carton, you found this Manual, some loose parts, and another smaller carton. Set the loose parts aside temporarily, and open the smaller carton. Then refer to Figure 1 and remove the cover from the kit as shown.

Remove the several small packs from the cabinet base, and set them aside. Then slide the cabinet top from the cabinet and set it aside. **IMPORTANT:** Do not remove any of the parts from the small packages until you are instructed to do so; some parts may be difficult to identify if you separate them from their packs or envelopes.

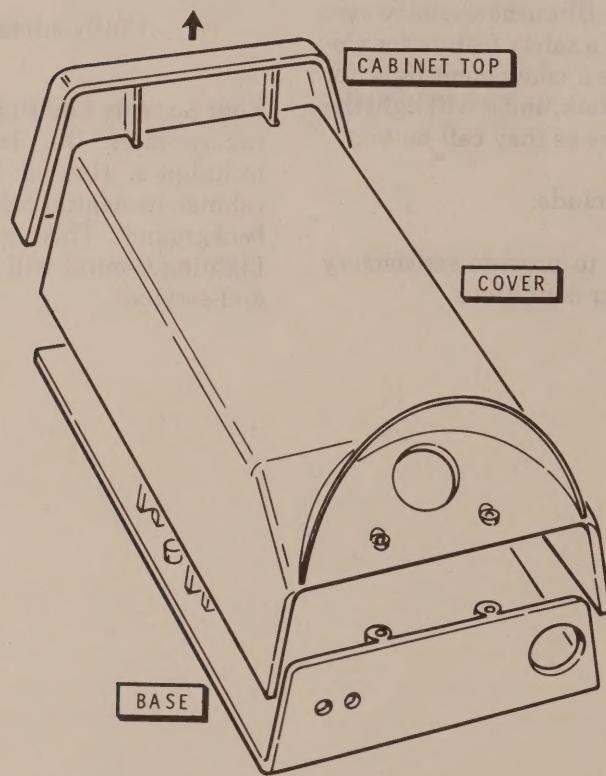
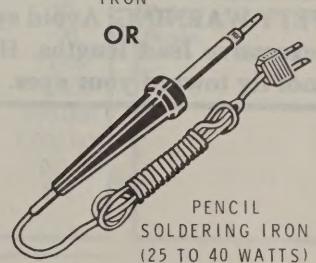
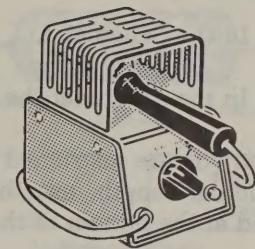
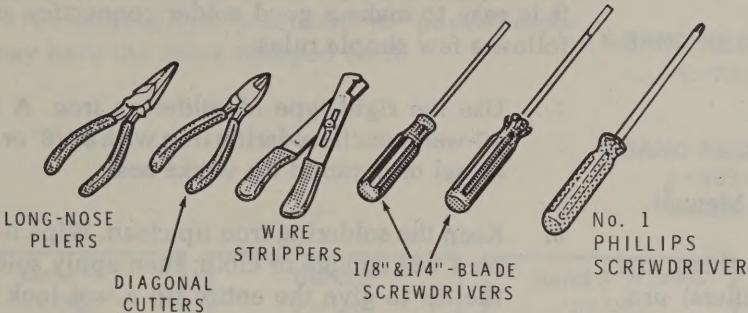
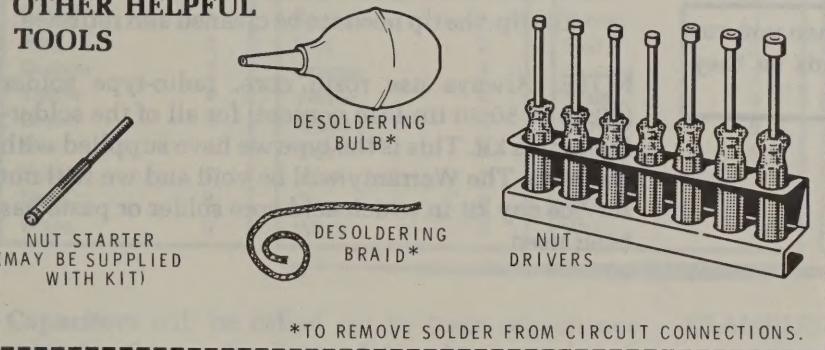


Figure 1

ASSEMBLY NOTES**TOOLS**

You will need these tools to assemble your kit.

**OTHER HELPFUL TOOLS**

*TO REMOVE SOLDER FROM CIRCUIT CONNECTIONS.

ASSEMBLY

1. Follow the instructions carefully. Read the entire step before you perform each operation.
2. The illustrations in the Manual are called Pictorials and Details. Pictorials show the overall operation for a group of assembly steps; Details generally illustrate a single step. When you are directed to refer to a certain Pictorial "for the following steps," continue using that Pictorial until you are referred to another Pictorial for another group of steps.
3. Most kits use a separate "Illustration Booklet" that contains illustrations (Pictorials, Details, etc.) that are too large for the Assembly Manual. Keep the "Illustration Booklet" with the Assembly Manual. The illustrations in it are arranged in Pictorial number sequence.
4. Position all parts as shown in the Pictorials.
5. Solder a part or a group of parts only when you are instructed to do so.

6. Each circuit part in an electronic kit has its own component number (R2, C4, etc.). Use these numbers when you want to identify the same part in the various sections of the Manual. These numbers, which are especially useful if a part has to be replaced, appear:
 - In the Parts List,
 - At the beginning of each step where a component is installed,
 - In some illustrations,
 - In the Schematic,
 - In the section at the rear of the Manual.
7. When you are instructed to cut something to a particular length, use the scales (rulers) provided at the bottom of the Manual pages.

SAFETY WARNING: Avoid eye injury when you cut off excessive lead lengths. Hold the leads so they cannot fly toward your eyes.

SOLDERING

Soldering is one of the most important operations you will perform while assembling your kit. A good solder connection will form an electrical connection between two parts, such as a component lead and a circuit board foil. A bad solder connection could prevent an otherwise well-assembled kit from operating properly.

It is easy to make a good solder connection if you follow a few simple rules:

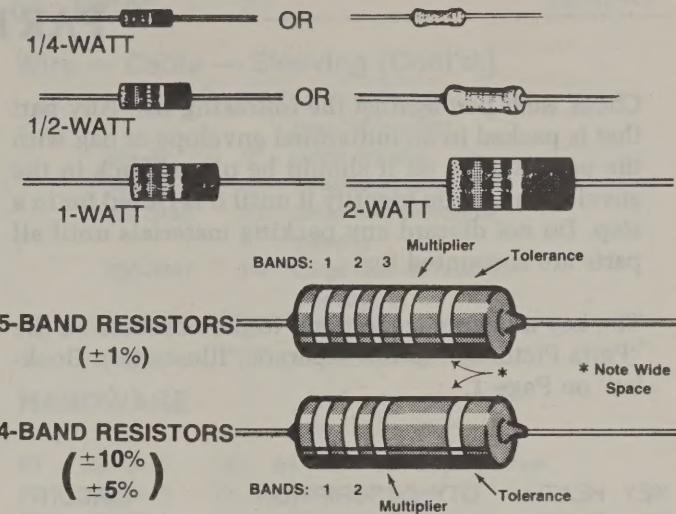
1. Use the right type of soldering iron. A 25 to 40-watt pencil soldering iron with a 1/8" or 3/16" chisel or pyramid tip works best.
2. Keep the soldering iron tip clean. Wipe it often on a wet sponge or cloth; then apply solder to the tip to give the entire tip a wet look. This process is called tinning, and it will protect the tip and enable you to make good connections. When solder tends to "ball" or does not stick to the tip, the tip needs to be cleaned and retinned.

NOTE: Always use rosin core, radio-type solder (60:40 or 50:50 tin-lead content) for all of the soldering in this kit. This is the type we have supplied with the parts. The Warranty will be void and we will not service any kit in which acid core solder or paste has been used.

Heathkit

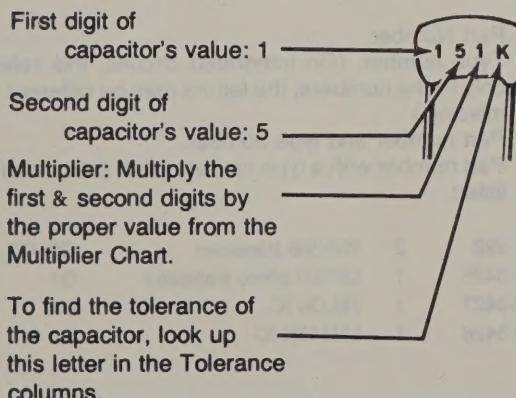
PARTS

Resistors are identified in Parts Lists and steps by their resistance value in Ω (ohms), $k\Omega$ (kilohms), or $M\Omega$ (megohms). They are usually identified by a color code and four or five color bands, where each color represents a number. These colors (except for the last band, which indicates a resistor's "tolerance") will be given in the steps in their proper order. Therefore, the following color code is given for information only. NOTE: Occasionally, a "precision" or "power" resistor may have the value stamped on it.



Band 1 1st Digit		Band 2 2nd Digit		Band 3 (if used) 3rd Digit		Multiplier		Resistance Tolerance	
Color	Digit	Color	Digit	Color	Digit	Color	Multiplier	Color	Tolerance
Black	0	Black	0	Black	0	Black	1	Silver	$\pm 10\%$
Brown	1	Brown	1	Brown	1	Brown	10	Gold	$\pm 5\%$
Red	2	Red	2	Red	2	Red	100	Brown	$\pm 1\%$
Orange	3	Orange	3	Orange	3	Orange	1,000		
Yellow	4	Yellow	4	Yellow	4	Yellow	10,000		
Green	5	Green	5	Green	5	Green	100,000		
Blue	6	Blue	6	Blue	6	Blue	1,000,000		
Violet	7	Violet	7	Violet	7	Silver	0.01		
Gray	8	Gray	8	Gray	8	Gold	0.1		
White	9	White	9	White	9				

Capacitors will be called out by their capacitance value in μF (microfarads) or pF (picofarads) and type: ceramic, Mylar*, electrolytic, etc. Some capacitors may have their value printed in the following manner:



EXAMPLES:

$$151\text{K} = 15 \times 10 = 150 \text{ pF}$$

$$759 = 75 \times 0.1 = 7.5 \text{ pF}$$

NOTE: The letter "R" may be used at times to signify a decimal point: as in: $2R2 = 2.2$ (pF or μF).

MULTIPLIER		TOLERANCE OF CAPACITOR		
FOR THE NUMBER:	MULTIPLY BY:	10 pF OR LESS	LETTER	OVER 10 pF
0	1	$\pm 0.1 \text{ pF}$	B	
1	10	$\pm 0.25 \text{ pF}$	C	
2	100	$\pm 0.5 \text{ pF}$	D	
3	1000	$\pm 1.0 \text{ pF}$	F	$\pm 1\%$
4	10,000	$\pm 2.0 \text{ pF}$	G	$\pm 2\%$
5	100,000		H	$\pm 3\%$
			J	$\pm 5\%$
8	0.01		K	$\pm 10\%$
9	0.1		M	$\pm 20\%$

PARTS LIST

Check each part against the following list. Any part that is packed in an individual envelope or bag with the part number on it should be placed back in the envelope after you identify it until it is called for in a step. Do not discard any packing materials until all parts are accounted for.

The key numbers correspond to the numbers on the "Parts Pictorial" in the separate "Illustration Booklet" on Page 1.

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
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RESISTORS

NOTES:

1. The following resistors are rated at 1/4-watt and have a tolerance of 5% unless otherwise noted.
2. The resistors may be packed in more than one envelope. Open all resistor envelopes before you check them against the Parts List.

A1	6-471-12	1	470 Ω (yel-viol-brn)	R26
A1	6-103-12	3	10 k Ω (brn-blk-org)	R18, R23, R24
A1	6-393-12	1	39 k Ω (org-wht-org)	R19
A1	6-473-12	1	47 k Ω (yel-viol-org)	Test
A1	6-513-12	1	51 k Ω (grn-brn-org)	R27
A1	6-104-12	6	100 k Ω (brn-blk-yel)	R1, R2, R3, R8, R21, R22
A1	6-184-12	1	180 k Ω (brn-gry-yel)	R20
A1	6-334-12	2	330 k Ω (org-org-yel)	R12, R13
A1	6-564-12	3	560 k Ω (grn-blu-yel)	R9, R10, R16
A1	6-105-12	3	1 M Ω (brn-blk-grn)	R7, R14, R15
A1	6-225-12	1	2.2 M Ω (red-red-grn)	R6
A1	230-3437	3	5.1 M Ω (grn-brn-grn)	R11, R17, R25
A1	1-157-12	1	10 M Ω (brn-blk-blu)	R5

To order a replacement part: Always include the PART NUMBER. Use the Parts Order Form furnished with the kit. If one is not available, see "Replacement Parts" inside the rear cover of the Manual. Your Warranty is located inside the front cover. For price information, refer to the separate "Heath Parts Price List."

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
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CAPACITORS

B1	27-74	2	.01 μ F (103 k) Mylar	C3, C10
B2	25-880	4	10 μ F electrolytic	C1, C2, C5, C8
B2	25-883	2	47 μ F electrolytic	C4, C6
B2	25-885	1	100 μ F electrolytic	C7
B2	25-891	1	470 μ F electrolytic	C9

DIODES — TRANSISTORS — INTEGRATED CIRCUITS (ICs)

C1	56-16	1	1N751 diode	D8
C1	56-84	4	1N4148 diode	D1, D2, D3, D4
C1	57-65	3	1N4001 diode	D5, D6, D7

NOTE: Transistors and integrated circuits may be marked for identification in any one of the following four ways:

1. Part Number.
2. Type number. (On integrated circuits, this refers only to the numbers; the letters may be different or missing.)
3. Part number and type number.
4. Part number with a type number other than the one listed.

C2	417-222	2	2N5308 transistor	Q2, Q3
C3	230-3425	1	OP500 photo transistor	Q1
C4	230-3427	1	78LO6 IC	U2
C5	230-3426	1	LM346N IC	U1

KEY No.	HEATH Part No.	QTY.	DESCRIPTION
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GENERAL

D1	230-3418	1	Detector module
D2	230-3420	1	Relay
D3	230-3421	1	Power transformer
D4	230-3439	1	250 KΩ control
D5	412-15	1	Neon lamp Solder

CABINET PARTS

E1	230-3401	1	Cabinet base
E2	230-3402	1	Cabinet top
E3	230-3403	1	Cover
E4	230-3404	1	Adapter plate
E5	230-3405	1	Detector bracket
E6	230-3415	1	Large plug
E7	230-3458	1	Small plug
E8	230-3457	3	Wire clip
E9	73-133	1	Insulator strip
	354-1	1	CABLE TIE

WIRE — CABLE — SLEEVING

89-49	1	Line cord
230-3451	1	Red/blk wire pair
344-15 2	12"	Large black wire
344-16 3	10"	Large red wire

CIRCUIT Comp. No.

KEY No.	HEATH Part No.	QTY.	DESCRIPTION
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CIRCUIT Comp. No.

Wire — Cable — Sleeving (Cont'd.)

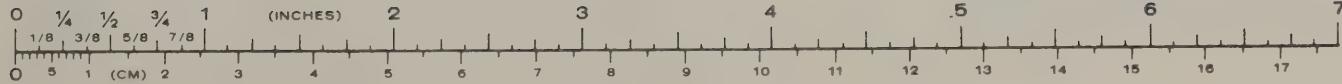
344-82 16	24"	Large white wire (two 12" lengths)
344-92	2"	Small red wire
344-99	2"	Small white wire
230-3446	1/2"	Small heat-shrinkable sleeving
230-3447	3/4"	Large heat-shrinkable sleeving
346-1	2"	Black fiber sleeving
346-7	2"	Clear sleeving

HARDWARE

F1	230-3410	5	#4 × 1/4" self-tapping screw
F2	230-3416	1	4-40 × 1/2" screw
F3	252-2	1	4-40 nut
F4	252-135	1	4-40 self-locking nut
F5	254-9	1	#4 lockwasher
F6	230-3412	2	#6 × 1" wood screw
F7	250-137	2	8-32 × 3/8" screw
F8	432-199	2	Small wire nut
F9	432-67	6	Large wire nut
F10	230-3414	1	Thin nylon washer
F11	230-3417	2	Thick nylon washer
F12	260-700	1	Transistor grommet
F13	260-701	1	Grommet retainer

PRINTED MATERIAL

G1	230-3456	1	Wiring label
G2		1	Blue and white label
G3	230-3461	1	"Conduit" label
	597-260	1	Parts Order Form
		1	Assembly Manual (See title page for part number.)



STEP-BY-STEP ASSEMBLY

CIRCUIT BOARD ASSEMBLY

START →

In the following steps, you will be given detailed instructions on how to install and solder the first part on the circuit board. Read and perform each step carefully. Then use the same procedure whenever you install parts on a circuit board.

() Position the circuit board as shown with the printed side (not the foil side) up.

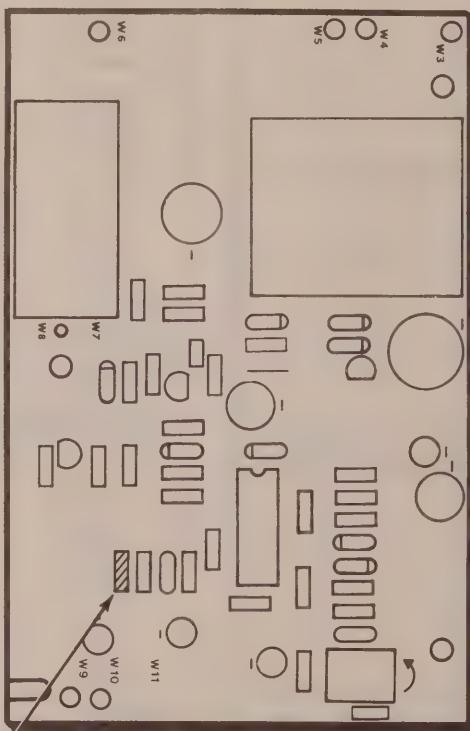
NOTE: When you install a component that has its value printed on it, position the value marking up, so it can be easily read. Diodes should be mounted with their type or part number up, if possible.

() Hold a 100 kΩ (brn-blk-yel) resistor with long-nose pliers and bend the leads straight down to fit the hole spacing on the circuit board.



() R1: Push the leads through the holes at the indicated location on the circuit board. The end with color bands may be positioned either way.

(!) Press the resistor against the circuit board. Then bend the leads outward slightly to hold the resistor in place.

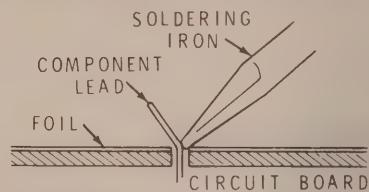


PICTORIAL 1-1

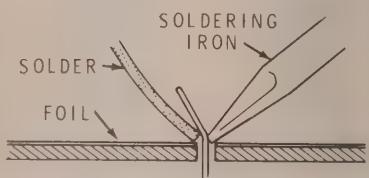
CONTINUE →

(↓) Solder the resistor leads to the circuit board as follows:

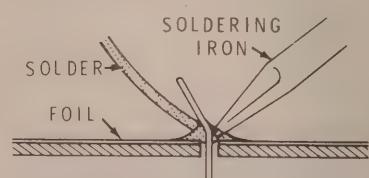
- Push the soldering iron tip against both the lead and the circuit board foil. Heat **both** for two or three seconds.



- Then apply solder to the other side of the connection. **IMPORTANT:** Let the heated lead and the circuit board foil melt the solder.



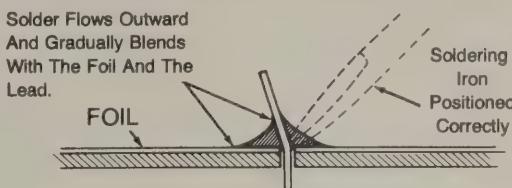
- As the solder begins to melt, allow it to flow around the connection. Then remove the solder and the iron and let the connection cool.



(!) Cut off the excess lead lengths close to the connection. **WARNING:** Clip the leads so the ends will not fly toward your eyes.

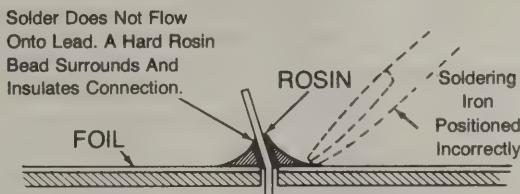
(!) Check each connection. Compare it to the illustrations on Page 11. After you have checked the solder connections, proceed with the assembly on Page 12. Use the same soldering procedure for each connection.

A GOOD SOLDER CONNECTION

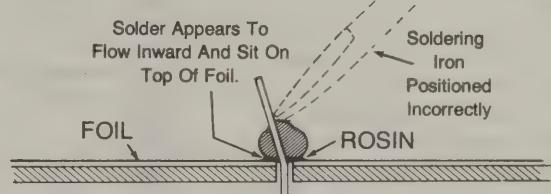


When you heat the lead and the circuit board foil at the same time, the solder will flow evenly onto the lead and the foil. The solder will make a good electrical connection between the lead and the foil.

POOR SOLDER CONNECTIONS



When the lead is not heated sufficiently, the solder will not flow onto the lead as shown above. To correct, reheat the connection and, if necessary, apply a small amount of additional solder to obtain a good connection.



When the foil is not heated sufficiently the solder will blob on the circuit board as shown above. To correct, reheat the connection and, if necessary, apply a small amount of additional solder to obtain a good connection.

SOLDER BRIDGES

A solder bridge between two adjacent foils is shown in photograph A. Photograph B shows how the connection should appear. A solder bridge may occur if you accidentally touch an adjacent previously soldered connection, if you use too much solder, or if you "drag" the soldering iron across other foils as you remove it from the connection. A good rule to follow is: always take a good look at the foil area around each lead before you solder it. Then, when you solder the connection, make sure the solder remains in this area and does not bridge to another foil. This is especially important when the foils are small and close together. NOTE: It is alright for solder to bridge two connections on the same foil.

Use only enough solder to make a good connection, and lift the soldering iron straight up from the circuit board. If a solder bridge should develop, turn the circuit board foil-side-down and heat the solder between connections. The excess solder will run onto the tip of the soldering iron, and this will remove the solder bridge. NOTE: The foil side of most circuit boards has a coating on it called "solder resist." This is a protective insulation to help prevent solder bridges.



A

SOLDER
BRIDGE

B

START 

NOTE: Some resistors may be secured together with strips of tape. If so, cut the tape from the resistor ends at this time.

(+) R17: 5.1 MΩ (grn-brn-grn).

(+) R16: 560 kΩ (grn-blu-yel).

(+) R19: 39 kΩ (org-wht-org).

(+) R15: 1 MΩ (brn-blk-grn).

(+) R18: 10 kΩ (brn-blk-org).

(+) R14: 1 MΩ (brn-blk-grn).

(+) Solder the leads to the foil and cut off the excess lead lengths.

(+) R24: 10 kΩ (brn-blk-org).

(+) R23: 10 kΩ (brn-blk-org).

(+) R22: 100 kΩ (brn-blk-yel).

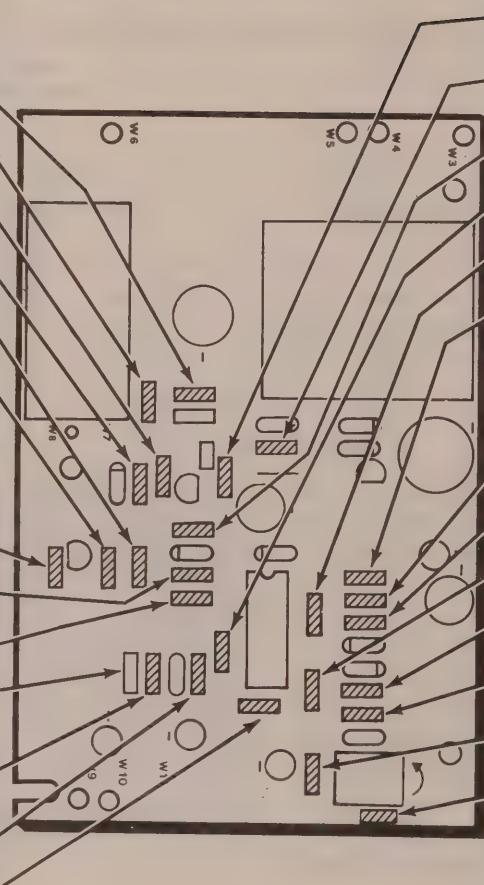
(+) Be sure this component was installed as directed in Pictorial 1-1.

(+) R2: 100 kΩ (brn-blk-yel).

(+) R5: 10 MΩ (brn-blk-blu).

(+) R13: 330 kΩ (org-org-yel).

(+) Solder the leads to the foil and cut off the excess lead lengths.

**CONTINUE** 

(+) R20: 180 kΩ (brn-gry-yel).

(+) R26: 470 Ω (yel-viol-brn).

(+) R21: 100 kΩ (brn-blk-yel).

(+) R12: 330 kΩ (org-org-yel).

(+) R11: 5.1 MΩ (grn-brn-grn).

(+) R25: 5.1 MΩ (grn-brn-grn).

(+) Solder the leads to the foil and cut off the excess lead lengths.

(+) R9: 560 kΩ (grn-blu-yel).

(+) R10: 560 kΩ (grn-blu-yel).

(+) R6: 2.2 MΩ (red-red-grn).

(+) R7: 1 MΩ (brn-blk-grn).

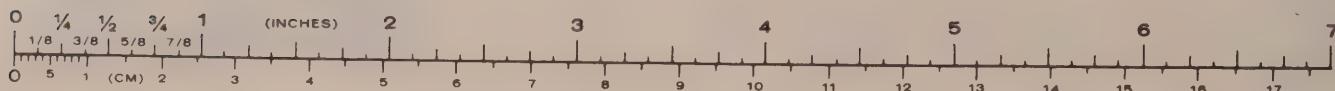
(+) R8: 100 kΩ (brn-blk-yel).

(+) R3: 100 kΩ (brn-blk-yel).

(+) R27: 51 kΩ (grn-brn-org).

(+) Solder the leads to the foil and cut off the excess lead lengths.

NOTE: The 47 kΩ (yel-viol-org) resistor will be used later.

PICTORIAL 1-2

START

NOTE: To prepare stranded wires, as in the next step, cut each wire to the length indicated and remove 1/4" of insulation from each wire end. Tightly twist each bare wire end and add a small amount of solder to hold the fine strands together.

(1) Prepare a 2" small red wire and a 2" small white wire.

NOTE: As you install the wires in the next two steps, solder the wires to the foil and cut off the excess ends.

(1) W2: 2" red wire.

(1) W1: 2" white wire.

NOTE: When you install diodes, as in the following steps, be sure you position the banded end of each diode as shown on the circuit board.



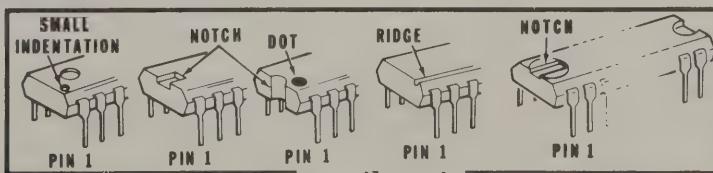
IMPORTANT: The 1N751 diode (#56-16), called for in a following step, is packaged apart from all the other diodes. Be sure not to use the 1N751 diode until it is called for in a step.

(1) D7: 1N4001 diode (#57-65).

(1) D4: 1N4148 diode (#56-84).

(1) D3: 1N4148 diode (#56-84).

(1) Solder the leads to the foil and cut off the excess lead lengths.



Detail 1-3A

CONTINUE

(1) D6: 1N4001 diode (#57-65).

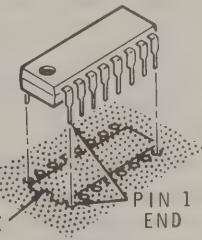
(1) D5: 1N4001 diode (#57-65).

(1) D8: 1N751 diode (#56-16).

(1) Solder the leads to the foil and cut off the excess lead lengths. Save one cut-off lead.

(1) J1: 1" bare wire jumper. Use the cut-off diode lead.

NOTE: Refer to Detail 1-3A to identify the IC pins. When you install the IC in the following step, be sure to match the pin 1 end of the IC with the index mark on the circuit board as shown. After you are certain all the pins are through the board, solder them to the foil.



PICTORIAL 1-3

(1) U1: LM346N IC (#230-3426).

(1) D2: 1N4148 diode (#56-84).

(1) D1: 1N4148 diode (#56-84).

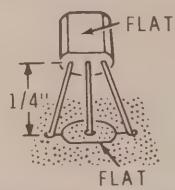
(1) R4: 250 kΩ control (#230-3439).



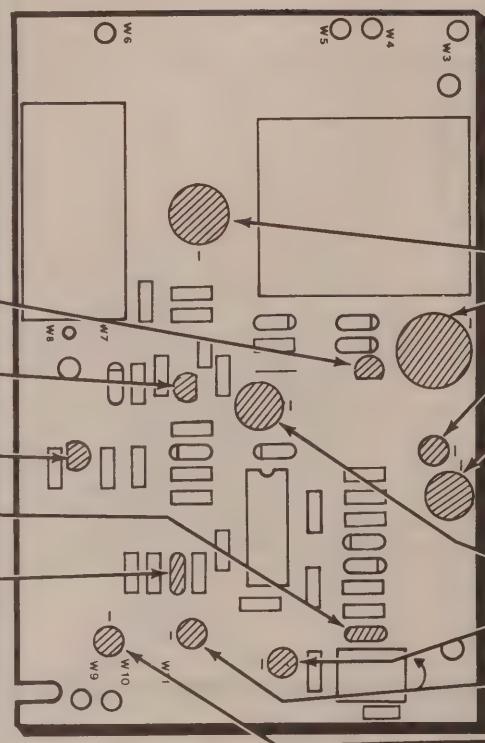
(1) Solder the leads to the foil and cut off the excess lead lengths.

START ▾

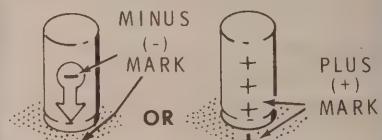
NOTE: Install the following transistors and integrated circuit in the manner shown. First line up the flat on the component with the outline of the flat on the circuit board. Insert the component leads into the corresponding holes. Solder each lead to the foil and cut off the excess lead lengths.



- () U2: 78L06 IC (#230-3427).
- () Q2: 2N5308 transistor (#417-222).
- () Q3: 2N5308 transistor (#417-222).
- () C10: .01 μ F (103K) Mylar.
- () C3: .01 μ F (103K) Mylar.
- () Solder the leads to the foil and cut off the excess lead lengths.

**CONTINUE** ▾

NOTE: When you install electrolytic capacitors, **ALWAYS** position the plus (+) mark on the capacitor toward the plus (+) mark on the circuit board. If the capacitor has only a minus (-) mark on it, position this **away** from the plus mark on the circuit board.

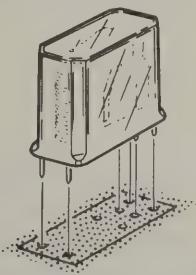


- () C7: 100 μ F electrolytic.
- () C9: 470 μ F electrolytic.
- () C5: 10 μ F electrolytic.
- () C4: 47 μ F electrolytic.
- () Solder the leads to the foil and cut off the excess lead lengths.
- () C6: 47 μ F electrolytic.
- () C8: 10 μ F electrolytic.
- () C2: 10 μ F electrolytic.
- () C1: 10 μ F electrolytic.
- () Solder the leads to the foil and cut off the excess lead lengths.

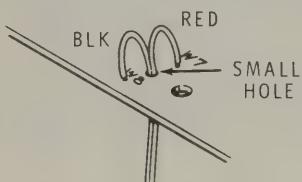
PICTORIAL 1-4

START

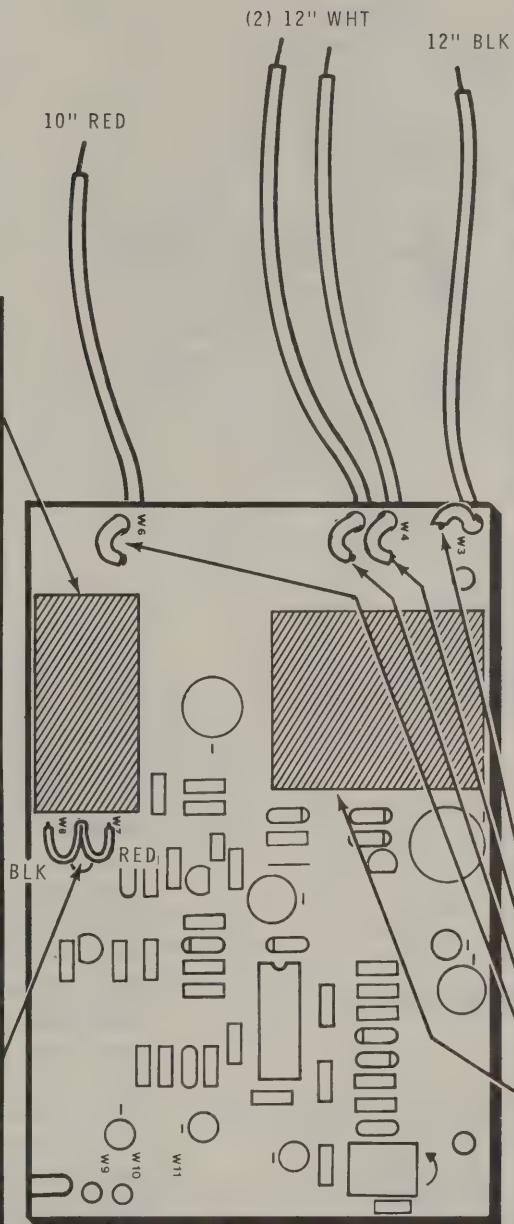
(1) K1: Be sure the relay lugs are straight. Then mount the relay at K1 as shown. Be sure the relay is all the way down onto the circuit board. Then solder the relay lugs to the foil. Cut off any excess lug ends.



(2) Locate the small red/blk wire pair. Separate the two wires $3/4"$ at both ends. Then, if necessary, remove $1/4"$ of insulation from each wire end.



(3) At one end of the red/blk wire pair, install and solder the black wire end into hole W8, and the red wire into hole W7. Cut off the excess wire ends. Then, from the top of the board, push the free ends down through the small hole between W7 and W8. Pull the wire pair until it is snug. The free end will be connected later.


PICTORIAL 1-5
CONTINUE

(1) If necessary, prepare both ends of the following wires. Do not add solder to the wire ends.

12" large blk.
Two 12" white.
10" red.

Install each of the following wires as follows: From the top of the board, install and solder each wire as it is called out. Solder the wire end to the foil and cut off the excess end. Then push the wire down through the adjacent hole as shown.



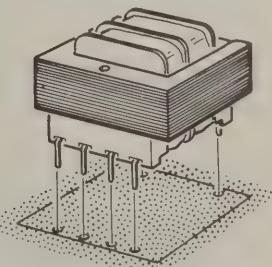
(1) 12" blk wire at W3.

(1) 12" wht wire at W4.

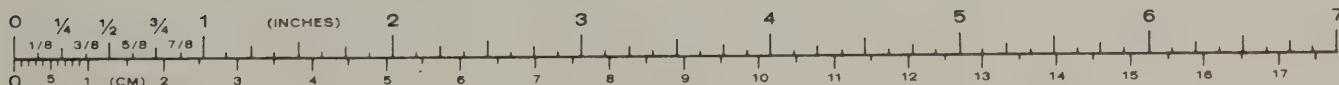
(1) 12" wht wire at W5.

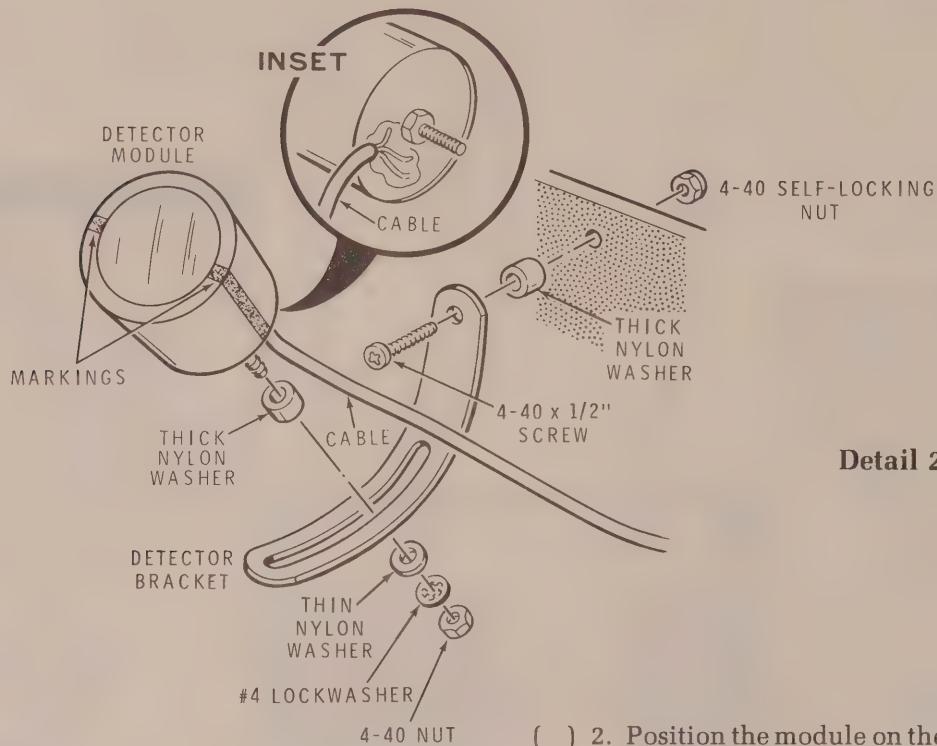
(1) 10" red wire at W6.

(1) T1: Be sure the power transformer leads are straight. Then mount the transformer at T1 as shown. Solder the leads to the foil and cut off the excess lead lengths.



Set the circuit board aside temporarily.





Detail 2-1A

CABINET ASSEMBLY

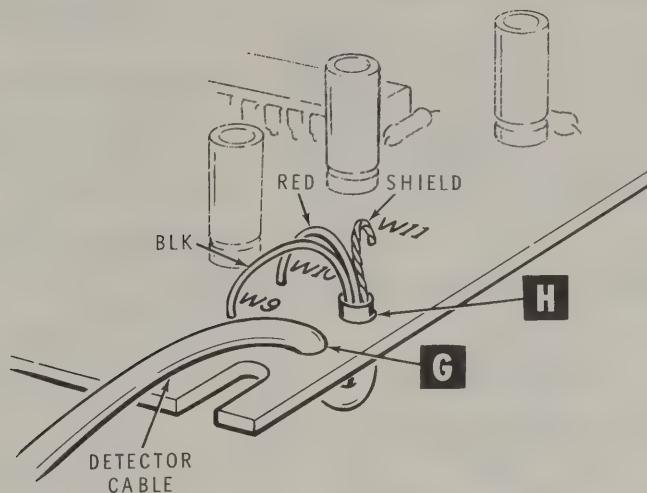
Refer to Pictorial 2-1 (Illustration Booklet, Page 2) for the following steps.

- (1) Position the cabinet base on your work area as shown.
- (1) Push a large plug into lower cabinet hole A as shown.
- ✗ (1) In the same manner, push the small plug into hole B.

Refer to Detail 2-1A for the next four steps.

- (1) 1. Place a thick nylon washer onto the detector module stud. Place the detector module stud through the slotted end of the detector bracket; then loosely secure the module with a thin nylon washer, a #4 lockwasher, and a 4-40 nut as shown.

- (1) 2. Position the module on the bracket so the two markings on the outer rim are positioned from side to side with respect to the bracket. Make sure the module cable emerges from the indicated side of the module housing as shown in the Pictorial. Also see the inset drawing on Detail 2-1A.
- (1) 3. Tighten the 4-40 nut on the module stud until, with slight difficulty, you can move the module stud up and down the bracket slot.
- (1) 4. Place a 4-40 × 1/2" screw through the top bracket hole. Place a thick nylon washer on the screw; then secure the top of the bracket to cabinet hole C with a 4-40 self-locking nut. Tighten the nut rather securely, but so you can turn the bracket on the screw when necessary.
- (1) Remove the paper backing from a wire clip and press the clip in place on the cabinet base at D as shown.
- (1) In the same manner, mount wire clips on the cabinet base at E and F.
- (1) Position the circuit board along side the cabinet base as shown in the Pictorial.



Detail 2-1B

Refer to Detail 2-1B for the next five steps.

(+) 1. Pass the free end of the cable coming from the detector module down through circuit board hole G, and then up through hole H as shown, until there is approximately 1-1/2" of cable above the top of the board.

Connect the cable wires as follows. As you connect each wire, solder it to the foil and cut off the excess end. Handle the wires carefully as they are very small.

(+) 2. Black wire to W9.
 (+) 3. Red wire to W10.
 (+) 4. Shield wire to W11.
 (+) 5. From the underside of the circuit board, pull the cable downward through hole H, and then upward through hole G to take the slack out of the end of the cable.

Refer to Pictorial 2-2 (Illustration Booklet, Page 2) for the following steps.

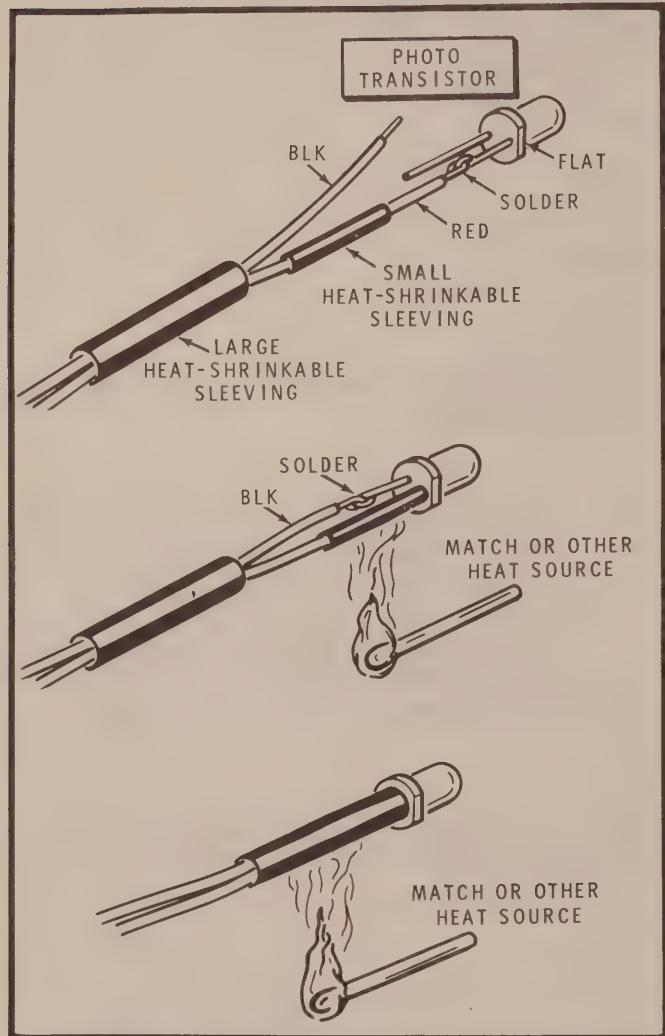
(+) Position the circuit board into the cabinet base, making sure the detector cable is down into the slot in the corner of the circuit board as shown. Also make sure all the remaining wire ends are positioned out the left side of the cabinet as shown. Secure the circuit board to the cabinet base with three #4 x 1/4" self-tapping screws.

(+) Push the detector module cable into wire clip E; then push firmly downward on the top of the clip to latch it.



Refer to Detail 2-2A for the next eight steps.

(+) 1. At the left of the circuit board, locate the small red/blk wire pair. Separate the wire ends for a length of $3/4"$. Then, if necessary, remove $1/4"$ of insulation from the wire ends. Tightly twist the bare wire ends and add a small amount of solder to hold the fine strands together.



Detail 2-2A

(+) 2. Slide the $3/4"$ (larger) piece of heat-shrinkable sleeving up onto the wire pair.

(+) 3. Slide the $1/2"$ (smaller) piece of heat-shrinkable sleeving onto the end of the small red wire. Then form a small hook in the end of the wire.

NOTE: In the following steps, when you bend the photo transistor leads, do not bend them at the base of the transistor.

(+) 4. Q1: Locate the small OP500 photo transistor (#230-3425). Note that the base flange is flattened at one side. Bend a small hook in the end of the lead at the flattened side of the transistor. Be careful to bend only the end of the lead.

(+) 5. Crimp the hook on the end of the red wire and the hook on the transistor lead together. Then solder the connection carefully so you do not solder the other transistor lead.

(+) 6. After the connection has cooled, slide the small sleeve up the red wire until it is snug against the underside of the photo transistor. Then, with a match or other similar source of heat, shrink the sleeve onto the wire and transistor lead. Do not get the sleeve too hot, and rotate the assembly as you apply the heat for just a few seconds.

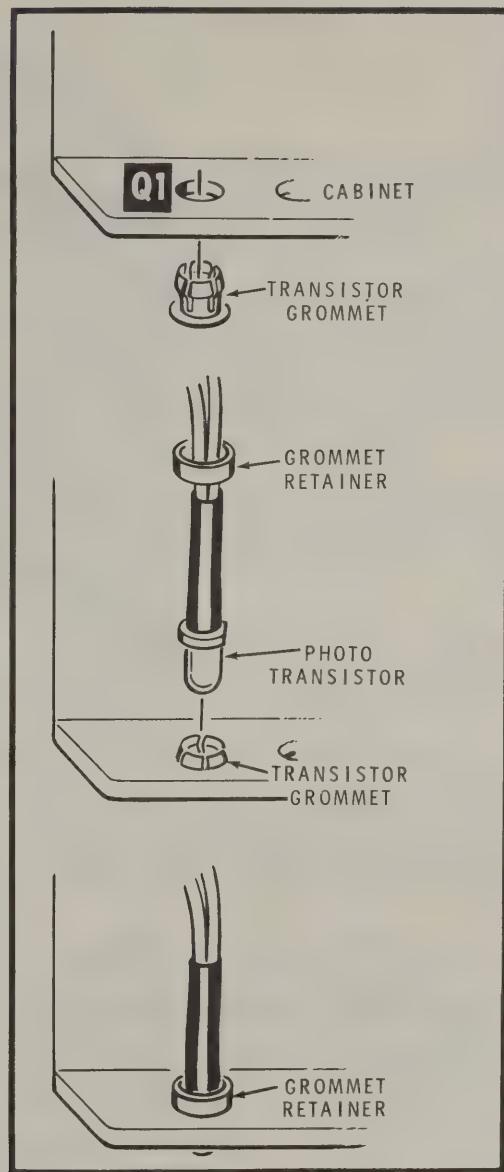
(+) 7. Form a hook in the other transistor lead and in the end of the small black wire. Crimp the wire and lead together and solder the connection.

(+) 8. Slide the larger sleeve up to the base of the photo transistor and, as in a previous step, shrink the sleeve around the base of the transistor assembly.

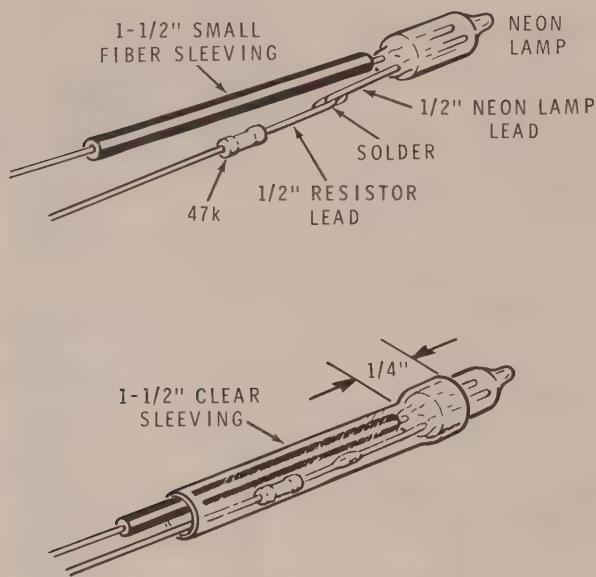


Refer to Detail 2-2B for the next three steps.

- () 1. Push the transistor grommet upward into the cabinet hole at Q1.
- () 2. Slide the grommet retainer upward onto the photo transistor wires. Then push the photo transistor all the way down into the transistor grommet.
- () 3. Slide the grommet retainer down the wires and push it firmly onto the outside of the grommet as shown.
- () Push the small red/blk wire pair into wire clip D, and snap the clip closed.
- () Slide the cabinet top onto the cabinet, making sure it is pushed all the way to the bottom of its slots as shown in Pictorial 2-2.
- () Route the four heavy wires at the left side of the circuit board around the top center partition and into the center compartment as shown. Secure the wires in under wire clip F. The free ends of these wires will be connected later.



Detail 2-2B



Detail 2-3A

Refer to Pictorial 2-3 (Illustration Booklet, Page 3) for the following steps.

() Cut the length of small fiber sleeving and the length of clear sleeving both to 1-1/2".

Refer to Detail 2-3A for the next five steps.

- () 1. Cut one lead of the neon lamp (#412-15) to 1/2".
- () 2. Cut one lead of a 47 kΩ resistor (yel-viol-org) to 1/2".
- () 3. Form a hook in the shortened resistor and lamp leads. Crimp the two hooks together and solder the connection.
- () 4. Place the 1-1/2" small fiber sleeve on the long lamp lead.
- () 5. Slide the clear sleeve up onto the leads of the neon lamp and resistor assembly as shown. Push the sleeve until it is approximately 1/4" up onto the base of the lamp.
- () In the center compartment, remove an additional 1/4" of insulation (total 1/2") from each of the four large wire ends.

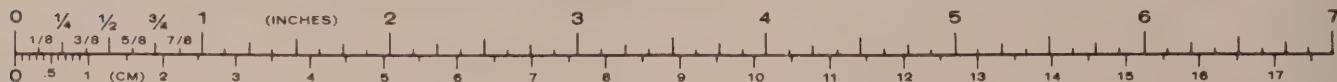
() In the center compartment of the cabinet, locate the red wire and either of the white wires. Twist one neon lamp lead onto the end of the red wire and one lead onto the end of the white wire. Turn a small wire nut onto each of the connections. CAUTION: Be sure any bare portions of these wires do not touch one another.

() Locate the line cord. Twist one line cord lead and the black lead in the center compartment together and twist a large wire nut onto the connection.

() In the same manner, secure the other line cord lead and the remaining white lead together with a large wire nut.

() Remove the paper backing from the "Conduit" label and press the label in place in the lower cabinet compartment as shown in Pictorial 2-3.

Except for "Final Assembly," this completes the step-by-step assembly of your kit. Proceed to "Initial Tests."



INITIAL TESTS

Refer to Pictorial 3-1 (Illustration Booklet, Page 3) for the following steps.

- () Position the cabinet assembly on your work area as shown.
- () At the upper right corner of the circuit board, turn the GAIN control to the center of its rotation.

CAUTION: Hazardous voltages are present in the indicated area of your circuit board whenever the line cord is plugged in. Avoid any contact with this area of the board, as these voltages are potentially lethal.

NOTE: In the following steps, if you fail to obtain the desired results, immediately disconnect the line cord from its outlet. Then refer to the "In Case of Difficulty" section of the Manual to determine the cause of the problem. Do **not** proceed until you have corrected the difficulty.

- () Plug the line cord into an AC outlet and check for the following conditions:
 - A. The relay should click to become activated.
 - B. The neon lamp should come on.

- () Allow the Lighting Control to remain on for several minutes as you carefully observe it. Check for any sign of overheating.
- () Turn the cabinet, taking care not to touch the circuit board, so the detector module is facing away from you. Be sure it does not face any other source of motion or heat. After a duration of several seconds, the relay should click again, and the neon lamp should go out.
- () Move your hand above the module, at a distance of three to four feet. Observe that the relay will activate and the neon lamp will come on.
- () Once again, move behind and away from the detector module, and check to make sure the lamp and relay deactivate after several seconds.

- () Disconnect the line cord from the AC outlet.

- () Remove the four wire nuts from the line cord and the neon lamp connections. Set the line cord and lamp assembly aside. **IMPORTANT:** The line cord is supplied for **test purposes only**; do **not** use it during your final installation.

This completes the "Initial Tests" of your Security Lighting Control.

INSTALLATION AND ADJUSTMENT

IMPORTANT NOTE: To comply with building codes, a qualified electrician may have to complete the installation of your Security Lighting Control. Check the requirements of your local building codes to determine how they apply to your installation.

Refer to Pictorials 4-1, 4-2, and 4-3 (Illustration Booklet, Page 4) for the following steps.

Before you proceed with the installation of your Security Lighting Control, you should consider some of the following points:

- A. The area of coverage of a single unit is 625 square feet, or approximately 25' x 25'. Larger coverage areas will require more than one Lighting Control. For example, if you wish back-yard as well as front-yard security coverage, you should use two Security Lighting Controls.
- B. You must be sure there is a source of AC power available at the Lighting Control and, in addition, you must route the controlled circuit (yard light, porch light, etc.) to the Lighting Control unit.
- C. As you determine the amount of lighting you wish to control, be sure the total power used does not exceed the 500-watt maximum capacity of any one Security Lighting Control unit.
- D. If you wish to use the Lighting Control at some interior location in conjunction with an alarm or emergency warning light (for example), make sure there is an ambient light source so you can disable the unit at any time you know that personnel will be in the coverage area. However, if your interior area is normally darkened, you can use the Lighting Control to automatically illuminate the work or storage area only during the times personnel are present. Then, you will not have to be concerned, hours later, whether someone remembered to switch off a light.

- E. Finally, you may apply the controlled output from the Lighting Control to any device that requires a 120 VAC source of power for its operation, providing you do not exceed the 500-watt rating of the output relay contacts.
- F. Choose a partially-sheltered exterior mounting location: for example, under an overhanging eave.

MOUNTING AND WIRING INSTRUCTIONS

Refer to Pictorials 4-4 and 4-5 (Illustration Booklet, Page 5) for the following steps.

- () Refer to Detail 4-4A (Illustration Booklet, Page 5) and cut the insulator strip as shown. Install the strip into the center (large) hole in the mounting plate.

NOTE: You can mount your Security Lighting Control in any number of ways; the following steps will suggest a typical example. You can install the mounting plate provided with your kit directly onto an exterior surface, or onto the top of a recessed or surface-mounted outlet box. Also note the 3/4" plug in the bottom of the cabinet; your installation may require you to route your wiring through this opening. The 3/4" hole was designed for use with a standard cable clamp. **Do not use rigid conduit directly installed on this unit.**

- () Position the mounting plate at the desired location. If it is on a wood surface, mark the large center hole and any two of the other mounting holes -- preferably at the top and bottom edges of the plate. If you are going to use a junction or outlet box, install it at this time with the appropriate clamps.

- () Predrill the two smaller holes with a drill slightly smaller than the diameter of the #6 x 1" mounting screws. If your installation is on a masonry surface, you will probably wish to use some type of screw anchor.
- () At the larger center hole outline, drill a 3/4" to 1" hole to accommodate the power wiring.

IMPORTANT: Look at the mounting plate and find the two small pre-tapped holes near the large center hole. To properly mount the Lighting Control cabinet, these tapped holes should be positioned **horizontally**.

- () Refer to the inset drawing on Pictorial 4-4 and install the mounting plate as shown. Note that **the sharp, pointed sides of the tapped, dimpled holes will be against the back of the cabinet**. This provides a small amount of spacing that is necessary for screw heads when junction box screws are used with the mounting plate.

NOTE: If you are going to use flexible, plastic-covered wiring, you may use the center compartment of the Lighting Control as a junction box. Otherwise, we recommend that you use a junction box on the inside of the wall, directly behind the Lighting Control mounting plate.

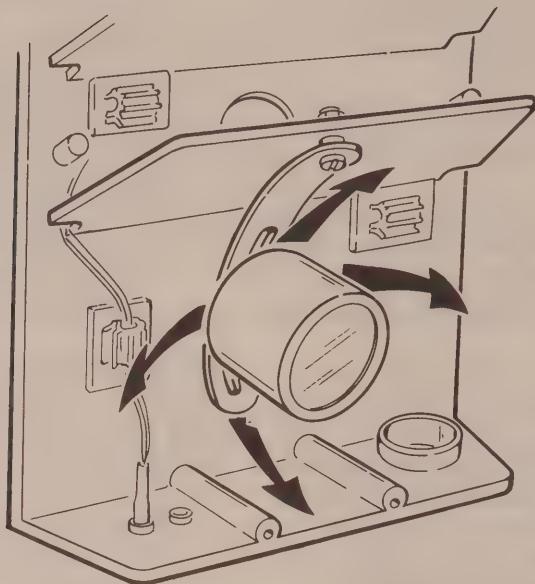
CAUTION: 120 VAC wiring should be serviced only by knowledgeable persons. If necessary, you should contact a licensed electrician to assist in the final wiring of your Security Lighting Control. When you proceed with the wiring, it is absolutely essential that the power service be temporarily interrupted, as 120 VAC power is potentially lethal.

- () If you are going to use the compartment inside the Control to connect these wires, route the wiring through the large hole in the mounting surface.
- () Similarly, route the wiring from the light circuit to be controlled by your kit. NOTE: Be sure the sum of the wattages of the controlled lights (or other controlled devices) does not exceed 500 watts. Route this wiring into the Lighting Control or junction box. NOTE: Mark the two cables so you can correctly identify them when you connect them to the Control's wiring.

In the following steps, tightly twist together the indicated wire ends, and secure each connection with a large wire nut. Standard wiring color codes are used in these steps.

- () Black (hot) wire from the power source and the black Lighting Control wire.
- () White (com) wire from the power source and either white Lighting Control wire.
- () Black (hot) wire to the controlled lighting circuit and the red Lighting Control wire.
- () White (com) wire to the controlled lighting circuit and the remaining white wire from the Lighting Control circuit.
- () If applicable, connect the ground (bare) wire coming from the power source to the ground wire going to the controlled circuit.
- () Fold the four wire connections and push them down into the center compartment (or into the junction box).
- () Secure the Lighting Control assembly to the mounting plate with two 8-32 x 3/8" screws. Do not overtighten the screws.

- () Turn off the 120 VAC power source, or remove the fuse from the line.
- () Route the power wiring from its source at a fused junction to the place you selected to install the Lighting Control.



PICTORIAL 4-6

ADJUSTMENTS

Refer to Pictorial 4-6 for the following steps.

- () Using a tissue or a soft cloth moistened with water, clean the mirrored surface of the detector module. DO NOT use cleaning solvents.
- () Plug the line cord into an AC outlet or turn on the power source to your Security Lighting Control. At this time, whenever the Control is activated, it will turn on the lights during daylight conditions, and will hold the lights on for a duration of only about 15 seconds.

NOTE: Before you perform the final adjustments on your Lighting Control, you should become familiar with some of the operational characteristics of your kit. Read the following information before you proceed.

When you turn the GAIN control on the circuit board counterclockwise, you will increase the circuit sensitivity; your Lighting Control will respond to much smaller changes in thermal currents in its coverage area. It is possible that swaying trees and shrubs will disturb the thermal currents enough to activate the unit. With the GAIN control turned clockwise, the unit will respond only to greater thermal changes, and may not detect all that is desired. Note, however, that the GAIN control will not affect the distance or range of the Lighting control; this is done when you adjust the lateral or vertical position of the detector module.

When you position the detector module, consider the coverage pattern and be sure it is not disturbed by any normal pedestrian or vehicular traffic pattern.

NOTE: Minor scratches, dust, or fingerprints on the mirrored surface of the detector module will not interfere with its operation. However, the mirrored surface will break if subjected to rough abuse.

Heathkit

In the following steps, it would be helpful if, for example, another person were to perform the "walking operations," as you make the necessary adjustments on the Lighting Control. Be sure you keep well to the side of the Control cabinet, and that you do not activate the light by moving your hands or arms in front of the detector module.

- () Check to be sure the GAIN control is turned to the center of its rotation.
- () Walk away from the coverage area approximately 75' to 100'. Pause long enough for the controlled light to go out.
- () As you slowly walk toward the "secure area," note the point at which the light comes on. Is that point further away than you wish it to be? Closer?
- () On the Lighting Control, slide the detector module upward in its slotted bracket to shorten the detection distance and downward to lengthen it.
- () Once again, walk far enough from the unit to allow the light to go out. Then recheck the point at which the light comes on. If necessary, readjust the vertical position of the detector module.
- () Repeat the vertical adjustment as much as is required.

NOTE: To adjust the detector module laterally, pivot the detector module mounting bracket slightly, as necessary, from side to side.

- () Walk out in front and to either side of the Lighting Control until the controlled light goes out. From either side, walk into the coverage area until the light comes on. Does it come on too soon or too late? Adjust the detector module bracket slightly toward the point you desire to be the earliest point of detection. Repeat this process as necessary.
- () Check the other side of the detection pattern and, if necessary, turn the mounting bracket slightly to balance these "side entry" detection points.

- () With a small screwdriver, turn the GAIN control fully clockwise.

NOTE: In the following step, adjust the GAIN control counterclockwise in 1/8-rotation steps until it detects a desired amount of thermal movement.

- () Walk across, in front of the Lighting Control, well within its coverage area. Adjust the GAIN control one step at a time, until the Lighting Control activates the connected light circuits. Turn the control 1/16 turn further counterclockwise.

NOTES:

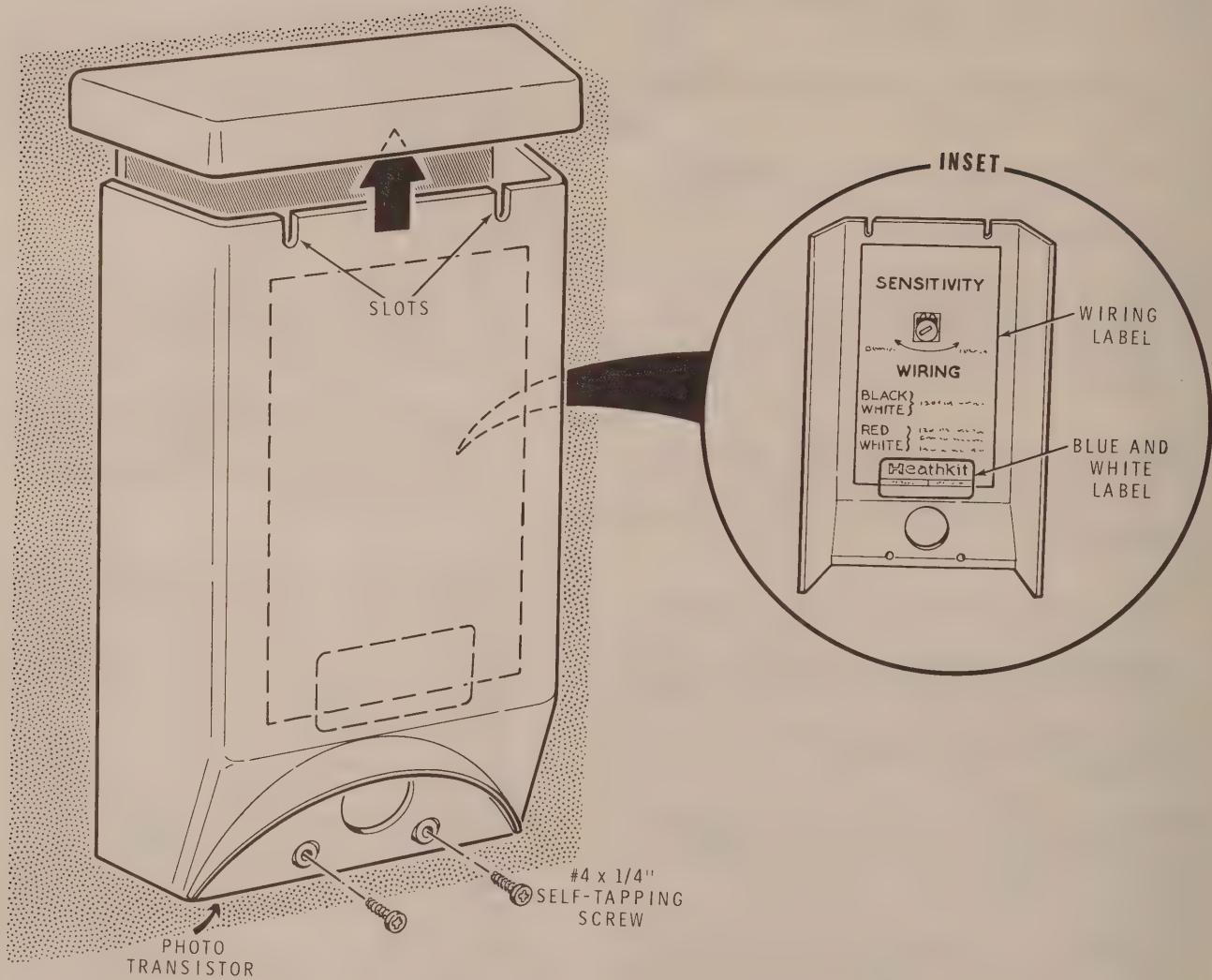
1. If, for any reason, you want the Lighting Control to operate at all times, do **not** cut the white wire at W1 in the following step.
2. If you want the controlled circuit to remain on for only a short duration, do **not** cut the red wire at W2 in the following step (see Figure 1, below).

- () When you are certain you have the detector module and the GAIN control properly adjusted to best suit your installation, first turn off the power. Then, with diagonal cutters, cut through the center of the 2" red wire loop and the 2" white wire loop at "W2" and "W1" near the center of the circuit board. NOTE: When these two wires are cut, the Security Lighting Control will activate your area lighting **only** during the hours of darkness. In addition, once the lighting has turned on, it will remain on for approximately four minutes after the last thermal activity in the coverage area is detected by the Control.

This completes the "Installation and Adjustment" of your Security Lighting Control. Proceed to "Final Assembly."

	Red Wire (W2)	White Wire (W1)
Uncut	On time — Approximately 15 seconds.	Operates at all times.
Cut	On time — Approximately 4 minutes.	Operates only during darkness

Figure 1



PICTORIAL 5-1

FINAL ASSEMBLY

Refer to Pictorial 5-1 on Page 26 for the following steps.

- () Refer to the inset drawing on the Pictorial and position the cabinet cover face down on your work area.
- () Remove the paper backing from the wiring (silver) label. Center the label on the inside of the cover as shown and, from one corner to a diagonal corner, carefully rub the label onto the surface to avoid wrinkles.
- () Remove the paper backing from the blue and white label and press the label in place on the bottom of the wiring label as shown. NOTE: Refer to the model and series numbers on the blue and white label in any correspondence you have with the Heath Company about your kit.

- () Turn the cover as shown in the Pictorial. Position the top edge of the cover under the front edge of the cabinet top as shown. Push upward on the cover so the slots in the leading edge are fitted around the ridges in the top. Then secure the cover to the cabinet assembly with two #4 x 1/4" self-tapping screws. Do not overtighten the screws, as this may strip the mounting bosses.

This completes the "Final Assembly" of your Security Lighting Control.

NOTE: As you observe the reactions of your unit in day-to-day operation, you may wish to slightly adjust the unit's GAIN control or the position of the detector module. You may do this during daylight hours if you place a small piece of black electricians tape over the photo transistor on the bottom of the cabinet. Note, however, that the recycle time will still be four minutes after the last detected motion. Remember to remove the tape from the photo transistor when you complete these readjustments.

OPERATION

The operation of your Security Lighting Control is entirely automatic. It is very sensitive to "heat in motion;" thus, a person, a vehicle, or an animal moving within the coverage area will activate the circuits and will turn on the controlled lighting circuit. It is more sensitive to cross-pattern movement than a motion directly toward or away from it.

Although the input power to your Lighting Control may be taken from a switched circuit (previously installed), the switch will serve only to completely defeat the operation of the Control. In normal operation, the photo transistor will deactivate the Control during normal daylight. When the surrounding light dims, the photo transistor circuit will detect this ab-

sence of light and turn on the detection circuit, thus enabling the controlled-lighting relay.

Once the controlled lighting comes on, it will remain on as long as the motion persists within the coverage area, and for approximately four additional minutes. At that time the internal holding circuit is released, the lighting will extinguish, and the unit will remain off until some new source of disturbance is detected.

Note that, in areas where seasonal temperature changes are greatest, you may have to adjust the sensitivity of the Lighting Control slightly to compensate for these seasonal variations.

IN CASE OF DIFFICULTY

Begin your search for any trouble that occurs after assembly by carefully following the steps listed below in the "Visual Tests." After you complete the "Visual Tests," refer to the "Troubleshooting Chart."

NOTE: Refer to the "Circuit Board X-Ray View" for the physical location of parts on the circuit board.

VISUAL TESTS

1. Recheck the wiring. Trace each wire in colored pencil on the Pictorial as it is checked. It is frequently helpful to have a friend check your work. Someone who is not familiar with the unit may notice something consistently overlooked by the kit builder.
2. About 90% of the kits that are returned to the Heath Company for repair do not function properly due to poor connections and soldering. Therefore, you can eliminate many troubles by reheating all connections to make sure they are soldered as described in the "Soldering" section of the "Assembly Notes." Be sure there are no solder "bridges" between circuit board foils.
3. Check to be sure that all transistors and diodes are in their proper locations. Make sure each lead is connected to the proper point. Make sure that each diode band is positioned above the band printed on the circuit board.
4. Check to be sure the pin 1 end of the IC matches the pin 1 end of the circuit board outline.

5. Check the values of the parts. Be sure in each step that the proper part has been wired into the circuit, as shown in the Pictorial diagrams. It would be easy, for example, to install a $470\ \Omega$ (yel-viol-brn) resistor where a $47\ k\Omega$ (yel-viol-org) resistor should be installed.
6. Check for solder bits, wire ends, or other foreign matter which may be lodged in the unit.
7. A review of the "Circuit Description" may also help you determine where the trouble is.

If you still do not locate the trouble after you complete the "Visual Tests," and a voltmeter is available, check voltage readings against those shown on the "Schematic Diagram." NOTE: All voltage readings were taken with a high input impedance voltmeter. Voltages may vary as much as 20%.

In an extreme case where you are unable to resolve a difficulty, refer to the "Customer Service" information inside the rear cover of the Manual. Your Warranty is located inside the front cover.

PRECAUTIONS FOR TROUBLESHOOTING

1. **CAUTION:** When the cabinet cover is removed, hazardous and potentially lethal voltages may be exposed. Refer to Pictorial 3-1 (Illustration Booklet, Page 3) and take all necessary precautions to avoid any contact within the "High Voltage Areas," as shown.
2. Be cautious when you test transistor circuits. Although they have almost unlimited life when used properly, they are vulnerable to damage from excessive voltage or current.

3. Be sure you do not short any terminals to ground when you make voltage measurements. If the voltmeter probe should slip, for example, and short across components or voltage sources, it is very likely to cause damage to one or more transistors or diodes.

SILICON BIPOLAR TRANSISTOR CHECKING

To check a transistor accurately, you should use a transistor checker. However, if one is not available, you can use an ohmmeter to determine the general condition of the transistors in this kit. The ohmmeter you use must have at least 1-volt DC at the probe tip to exceed the threshold of the diode junctions on the transistor being tested. Most vacuum tube voltmeters meet this requirement.

To check a transistor with an ohmmeter, proceed as follows:

1. Remove the transistor from the circuit.

2. Set the ohmmeter on the $R \times 1000$ range.
3. Connect one of the ohmmeter test leads to the base (B) of the transistor. Touch the other meter lead to the emitter (E) and then to the collector (C). Both readings should be approximately the same, but may be either high or low. If one reading is high and the other low, the transistor should be replaced. (Identify the transistor leads on the Semiconductor Identification Chart on Page 35.)
4. Repeat step 3 with the test leads reversed.
5. Check the resistance from the collector to the emitter to make sure there is no short circuit.

NOTE: In the unusual case when the readings are all low, or all high, no matter which ohmmeter lead is connected to the base, the transistor should be replaced.

Troubleshooting Chart

The following chart lists the "Problem" and the "Possible Cause" of a number of malfunctions. Under some of the conditions you will find several tests you can make. These should help you narrow down the problem to a specific area within a particular circuit. If a particular part or parts are mentioned (transistor

Q2, for example, or relay K1) as a possible cause, check these parts to see if they are wired or installed incorrectly. Also check to see if an improper part was installed at that location. It is also possible, on rare occasions, for a part to be faulty.

PROBLEM	POSSIBLE CAUSE
Lighting Control inoperative (after installation).	<ol style="list-style-type: none"> 1. Power source fuse or circuit breaker. 2. Defective controlled lights. 3. Wire connections from power source or to controlled lights.
Controlled lighting comes on during daylight.	<ol style="list-style-type: none"> 1. Wire jumper W1 not cut. 2. Transistors Q1 or Q2.
Relay energizes, but controlled lighting does not come on.	<ol style="list-style-type: none"> 1. Relay K1 contacts. 2. Wiring at W3/W4 or W5/W6. 3. Output wire connections. 4. Defective controlled lights. 5. Test lamp defective (during "Initial Tests").
Incorrect B+ voltage at input to regulator IC U2.	<ol style="list-style-type: none"> 1. Transformer T1. 2. Diode D5. 3. Capacitor C9.
Incorrect negative (-) power supply voltages.	<ol style="list-style-type: none"> 1. Diodes D7 or D8. 2. Capacitor C7. 3. Resistor R26. 4. Integrated circuit U1.
Incorrect output voltage from IC U2.	<ol style="list-style-type: none"> 1. Integrated circuit U2. 2. Capacitor C5. 3. Detector module wiring.
Controlled lighting goes out too quickly.	<ol style="list-style-type: none"> 1. Wire jumper W2 not cut. 2. Capacitor C6. 3. Resistor R17.
Relay will not deenergize; controlled lighting stays on.	<ol style="list-style-type: none"> 1. Detector module. 2. Integrated circuit U1. 3. Transistor Q3.
Gain control has no effect.	<ol style="list-style-type: none"> 1. Control R4. 2. Integrated circuit U1. 3. Resistor R27.

SPECIFICATIONS

Mounting	Flat surface.
Range	25 ft.
Detection Pattern (adjustable)	25 ft. × 25 ft.
Detector	Passive infrared, 6-zone array.
Sensitivity	Adjustable.
Time Delay (after last motion within pattern)	
Test wired	Approximately 10-30 seconds.
Normal Operation	Approximately 3-5 minutes.
Relay Contact Rating	4.2A, 120 VAC.
Daylight Sensor	OP500 Photo Transistor.
Maximum Lighting Load	500 watts.
Power Requirements	
(Lighting Control only)	120 VAC, 60 Hz, 1 watt.
Size (overall)	8" × 5-1/2" × 3-1/4" (20.3 × 14 × 8.1 cm.).
Net Weight	1-1/2 lb. (680 g.).

The Heath Company reserves the right to discontinue products and to change specifications at any time without incurring any obligation to incorporate new features in products previously sold.

CIRCUIT DESCRIPTION

Refer to the Schematic Diagram as you read the following information. The physical location of the circuit components is shown on the "Circuit Board X-Ray View" (Page 34).

DETECTION CIRCUIT

When the detector module is activated by a source of heat and motion within its coverage area, a signal is routed into fixed-gain amplifier IC U1B. This input signal is filtered by capacitor C1 and resistor R1. The gain of this stage is fixed by the ratio of resistor R2 at input pin 6 and feedback resistor R5. The output from U1B is coupled to the input of variable gain amplifier U1C through capacitor C2.

The output of amplifier U1C at pin 10 is fed back to input pin 11 through resistor R6. The variable gain of this stage is set by control R4, which is connected indirectly to input pin 11 of the IC. Capacitors C8 and C10 serve to further filter any transients from the amplified signal at this stage. The overall sensitivity of the Lighting Control is established by the rotational position of control R4.

From pin 10 of U1C, the amplified and filtered output is coupled to window filter diodes D1 and D2. During the positive and negative excursions of the input signal, either of the filter diodes will conduct when the signal is of great enough magnitude. The diodes will effectively block signals detected by the sensitive detector module unless they are large enough to overcome the preset bias of the stage. Thus, very small changes in the area will not activate the unit. The positive and negative bias is established by the network consisting of resistor R9 and R25 in the positive circuit, and by resistor R10 and R11 in the negative circuit. Both bias levels are kept constant by the action of capacitor C4.

The detected positive and negative-going signals are coupled to input pins 14 and 15 of operational amplifier IC U1D. The output of this stage is a string of positive-going, amplified pulses which are coupled across a time-delay network consisting of capacitor C6 and resistors R20 and R17. Note that R17 is bypassed by a jumper wire. This wire is used only during the initial test phase of development and effectively cuts the output "on time" from approximately 4 minutes to approximately 15 seconds. Once the initial tests have been completed, this wire is cut and R17 is then an effective circuit component.

Operational amplifier IC U1A further amplifies the pulses and turns on relay driver transistor Q3. When Q3 conducts, it places a ground on the coil of relay K1, causing it to conduct. As the relay conducts, its contacts close, thus connecting an AC voltage coming from the "hot" 120-volt AC input to the output-controlled lighting circuit.

After the last motion is "seen" by the detector module, an absence of activating signals causes the circuits to become nonconductive. However, the charge on time-delay capacitor C6 is held high for a period of time, until the high resistance of the R17-R20 resistor network eventually allows this capacitor to become neutralized, and to thus remove the driving signal from the following stages. When the voltage required to overcome the base-emitter bias on driver transistor Q3 has diminished Q3 turns off and becomes an open circuit in the relay coil current path, the coil deenergizes, and the relay contacts open up to turn off the controlled lighting.

PHOTO TRANSISTOR CIRCUIT

During daylight hours, or any time there is light in the area of the Lighting Control, the output of operational amplifier U1A is inhibited by a signal from photo transistor Q1 and its associated circuits.

When the ambient light is detected by photo transistor Q1, which is exposed to the outside of the cabinet, Q1 will be cut off, or not conducting. The positive voltage applied through resistors R14 and R15 to the base of driver transistor Q2 effectively holds Q2 cut off. This same action causes a positive voltage to be applied to the (-) input of amplifier U1A, holding that stage cut off, inhibiting the relay circuit.

Note that the emitter ground of transistor Q2 is temporarily bypassed to the collector output to defeat the action of the photo transistor during daylight hours for the purpose of performing the initial tests. The negative-going signal felt at the input of amplifier IC U1A allows it to conduct to drive the output relay until the wire loop at Q2 is cut open during the final assembly of the Lighting Control.

At any time during the hours of darkness, photo transistor Q1 will note the absence of light and it will conduct. As Q1 conducts, the positive bias on the base of driver transistor Q2 is lowered and Q2 will also

conduct, effectively placing a ground at the collector output. When this negative-going voltage is applied through resistor R21 to the pin 2 input of U1A, the IC will be allowed to conduct at any time it also has an enabling detected-motion signal at its pin 3 input.

POWER SUPPLY

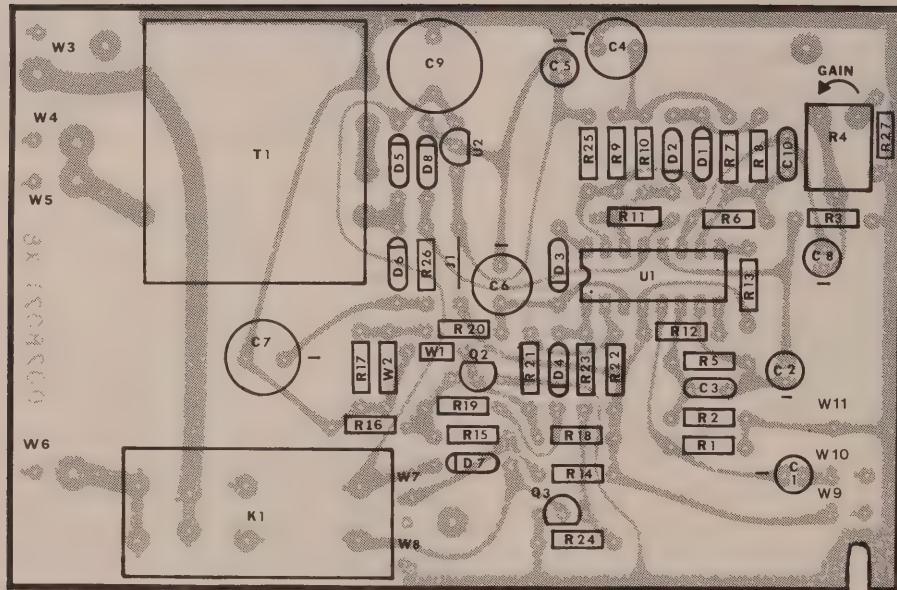
The Security Lighting Control is connected to a 120 VAC, 60 Hz. source. This input to transformer T1 is also routed to the contacts of output relay K1 which, when closed, becomes the output to the controlled lighting circuits. The secondary circuit of transformer T1 is routed through half-wave rectifier diode D5 to create a positive DC voltage that supplies regulator IC U2, and the supply voltages for driver transistor Q3 and relay coil K1. The positive input voltage is filtered by capacitor C9. Regulator IC U2 drops the incoming +15 — +17 DC volts to a stable +5.9 volts at its output, which is then utilized as the supply for the remaining circuits in the unit.

Diode D6 is also a half-wave rectifier, connected to the secondary of T1, which produces the negative voltages used in the unit. The output of D6 is filtered by capacitor C7 and is regulated to a constant -5.3 volts DC by the action of zener diode D8. This negative supply voltage is used primarily in the window diode circuit of D2, at input pins 13 and 14 of IC U1D.

CIRCUIT BOARD X-RAY VIEW

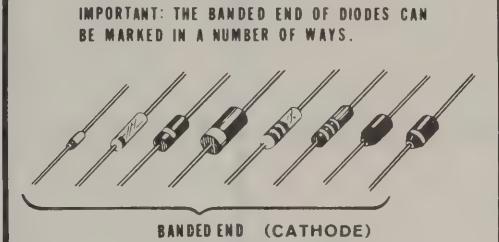
NOTE: To find the PART NUMBER of a component for the purpose of ordering a replacement part:

- A. Find the circuit component number (R1, C1, etc.) on the "X-Ray View."
- B. Locate this same number in the "Circuit
- C. Adjacent to the circuit component number, you will find the PART NUMBER and DESCRIPTION which must be supplied when you order a replacement part.

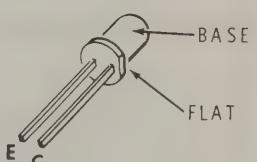
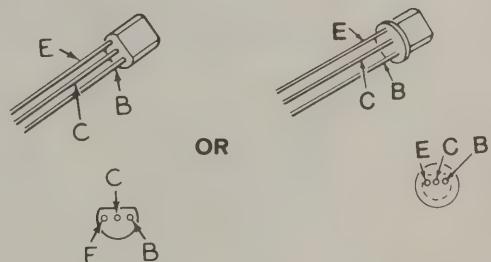


(Shown from the component side.)

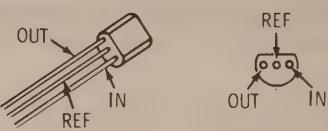
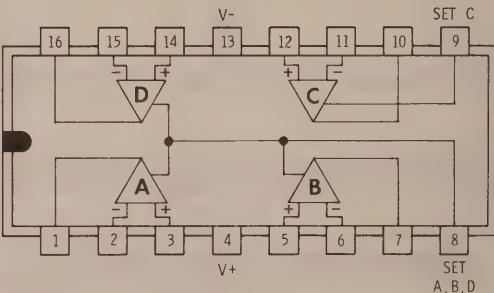
SEMICONDUCTOR IDENTIFICATION CHARTS**DIODES**

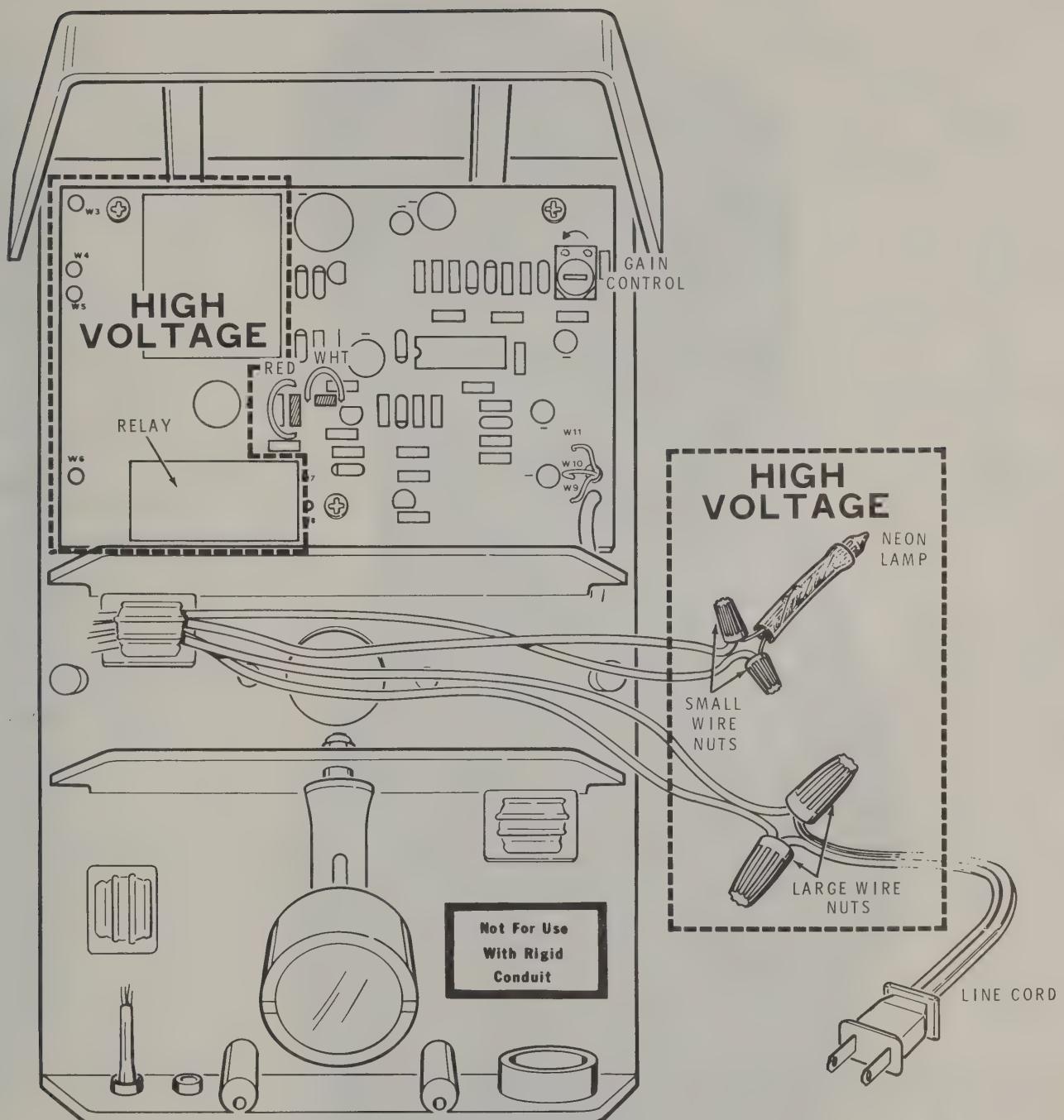
COMPONENT NUMBER	HEATH PART NUMBER	MAY BE REPLACED WITH	IDENTIFICATION
D1, D2, D3, D4	56-84	1N4148	
D8	56-16	1N751	
D5, D6, D7	57-65	1N4001 1N4002	<p>IMPORTANT: THE BANDED END OF DIODES CAN BE MARKED IN A NUMBER OF WAYS.</p>  <p>BANDED END (CATHODE)</p>

TRANSISTORS

COMPONENT NUMBER	HEATH PART NUMBER	MAY BE REPLACED WITH	IDENTIFICATION
Q1	230-3425	OP500	
Q2, Q3	417-222	2N5308	 <p>OR</p>

INTEGRATED CIRCUITS

COMPONENT NUMBER	HEATH PART NUMBER	MAY BE REPLACED WITH	IDENTIFICATION
U2	230-3427	78L06	
U1	230-3426.	LM346N	



PICTORIAL 3-1

PICTORIAL 4-2

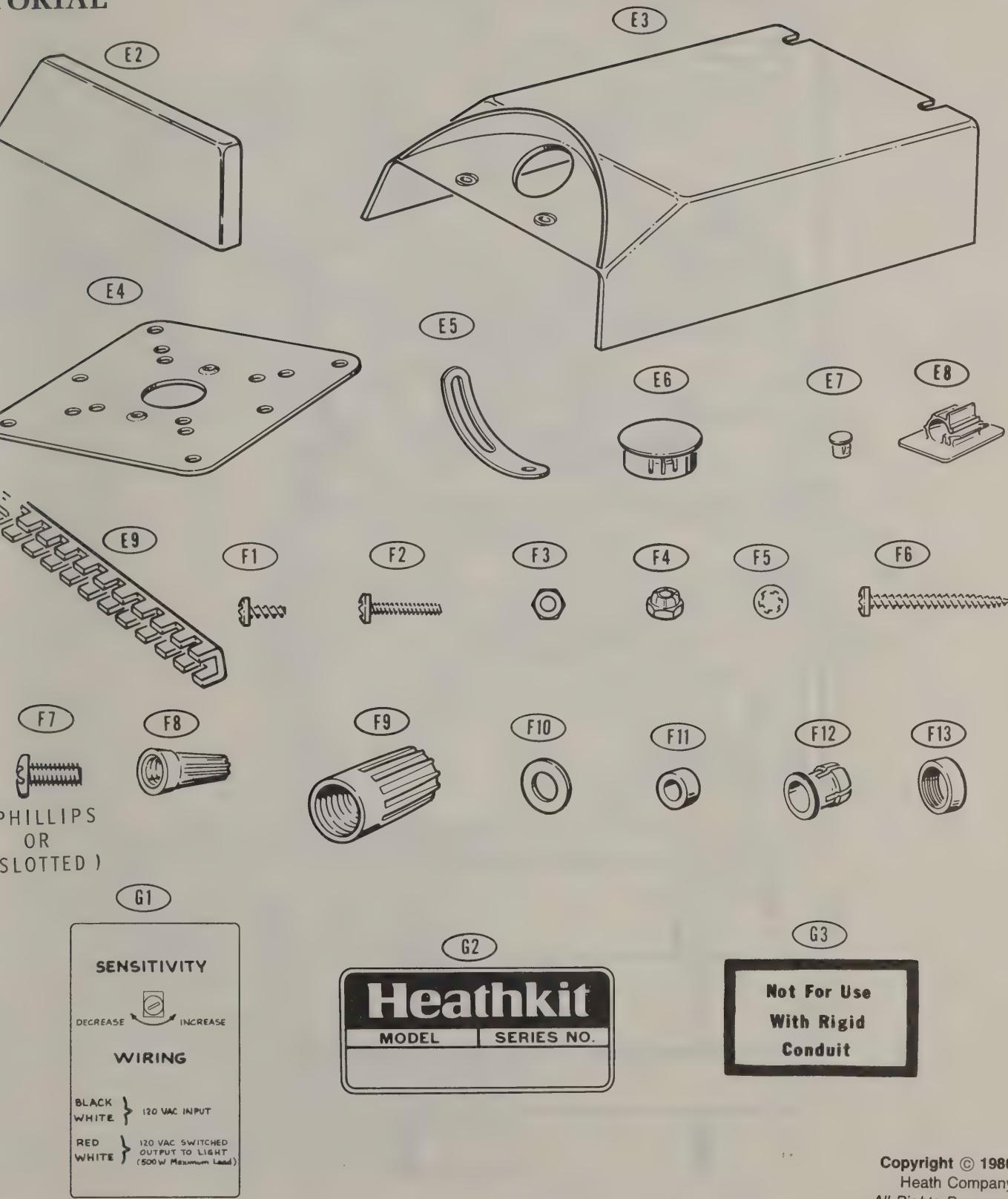


PICTORIAL 4-3

IN BOOKLET

Part of 595-2453

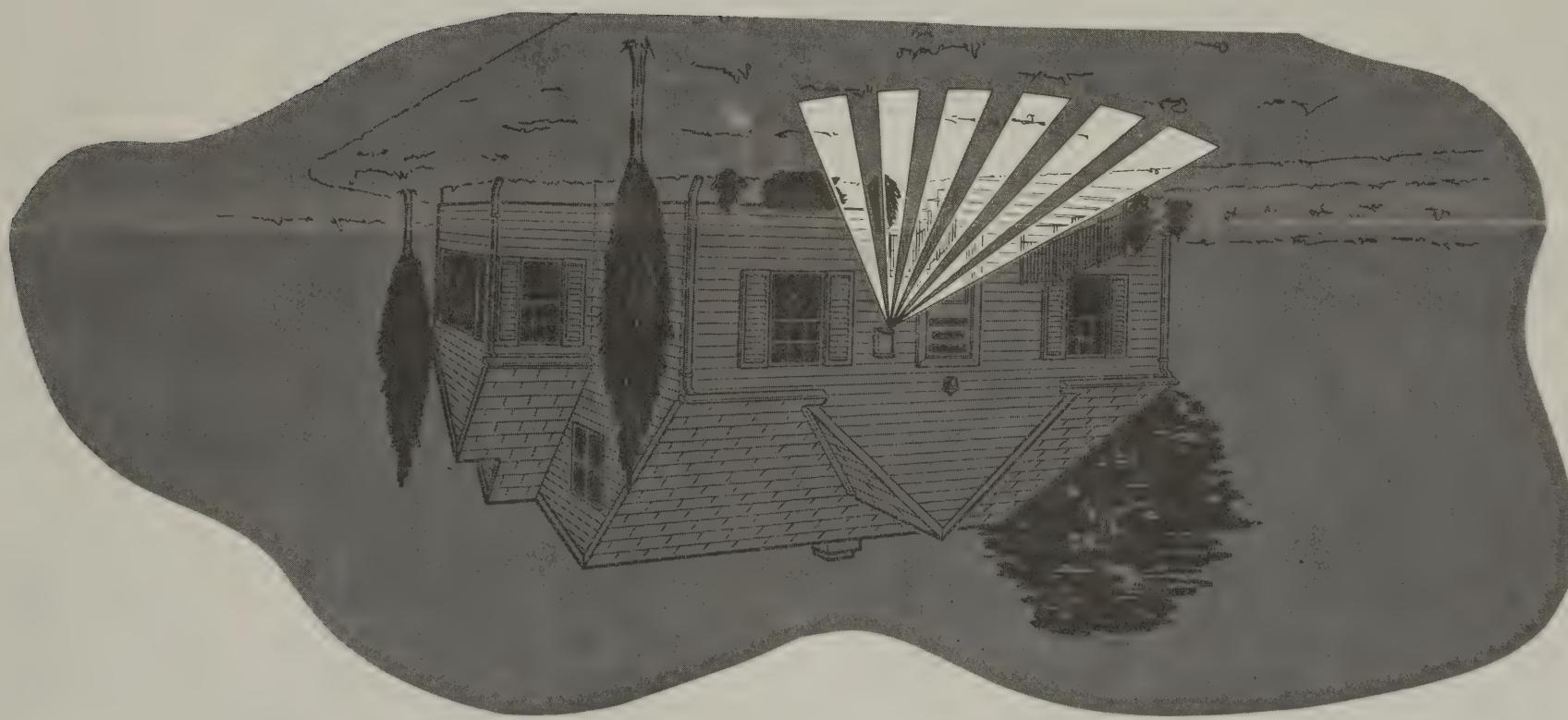
TORIAL



PICTORIAL 4-3



PICTORIAL 4-2



PICTORIAL 4-1



SCHEMATIC OF THE
HEATHKIT®
SECURITY LIGHTING CONTROL
MODEL GD-3510

NOTES:

1. RESISTORS ARE 1/4-WATT, 5% TOLERANCE UNLESS OTHERWISE NOTED (K=1000, M=1,000,000).
2. ALL CAPACITORS ARE IN μ F (MICROFARADS).
3. THIS SYMBOL INDICATES A CIRCUIT BOARD WIRE CONNECTION.
4. THIS SYMBOL INDICATES A CIRCUIT BOARD GROUND.
5. THE FOLLOWING SYMBOLS INDICATE A DC VOLTAGE MEASURED WITH A HIGH IMPEDANCE INPUT VOLTMETER FROM THE POINT INDICATED TO CIRCUIT BOARD GROUND. VOLTAGES MAY VARY $\pm 20\%$.
 - = STEADY DC VOLTAGE
 - = RELAY ENERGIZED
 - = RELAY DEENERGIZED
 - * = VOLTAGE VARIABLE WHEN RELAY ENERGIZED
6. REFER TO THE "CIRCUIT BOARD X-RAY VIEW" FOR THE PHYSICAL LOCATION OF COMPONENTS.

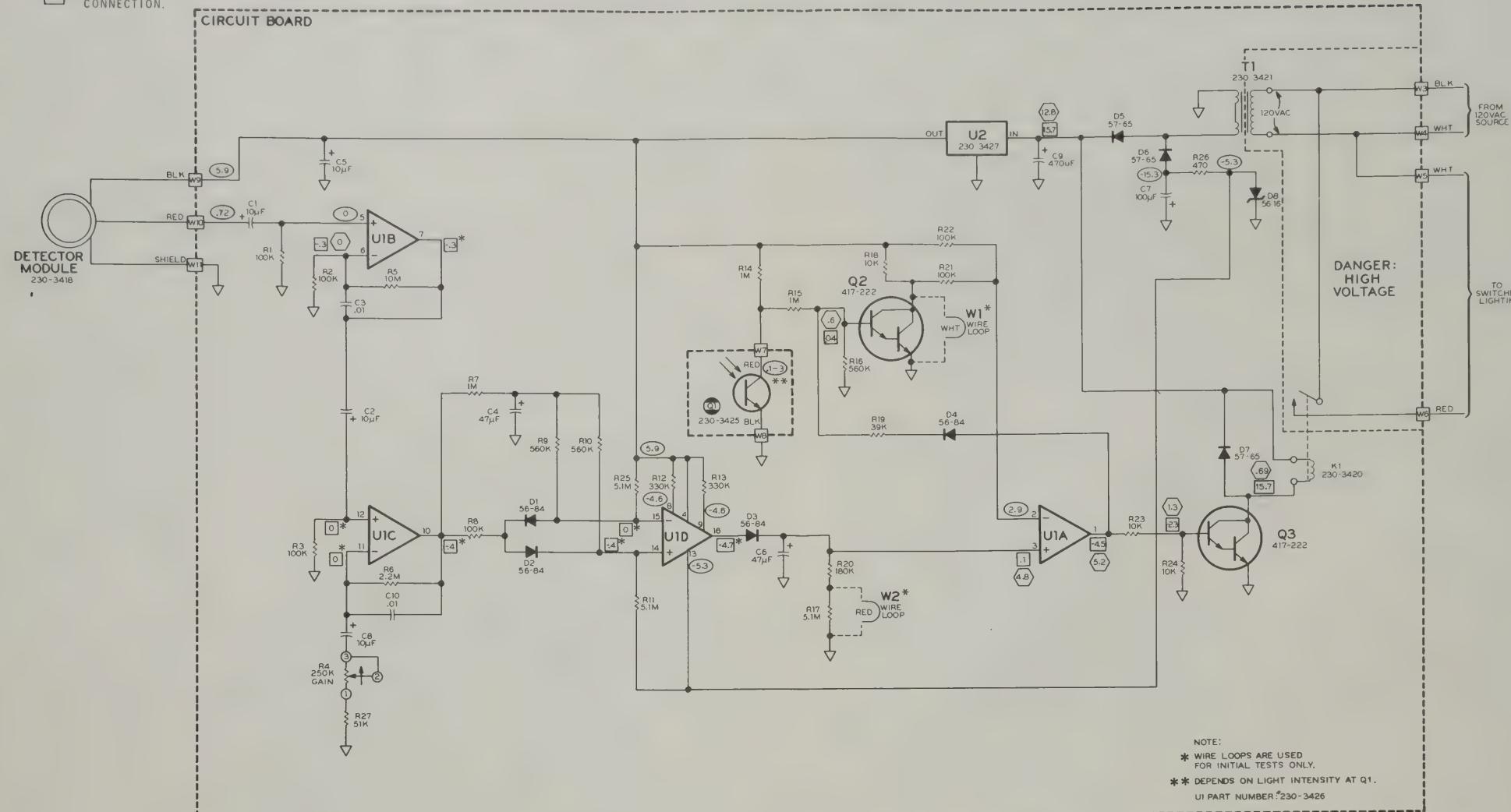
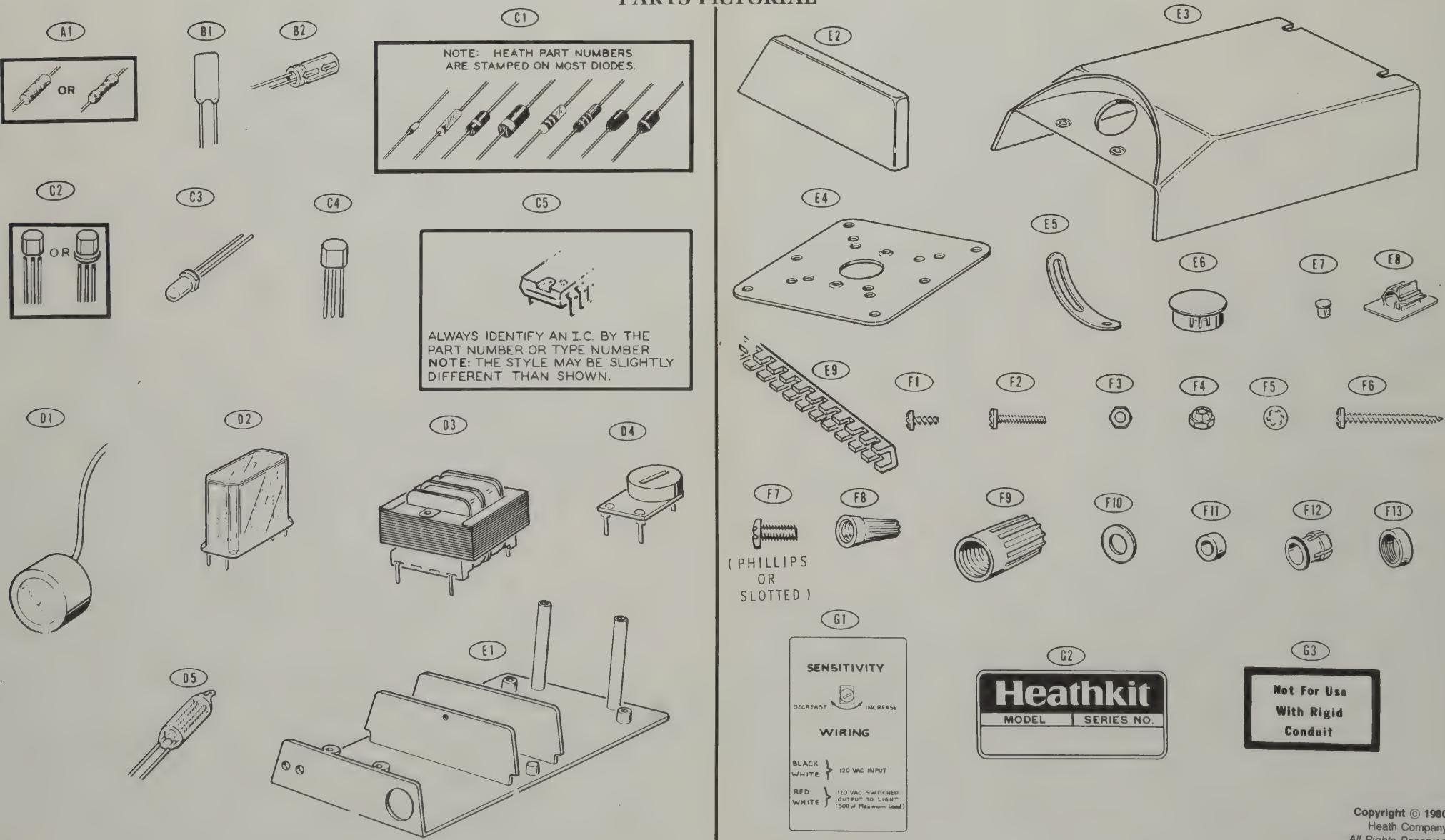
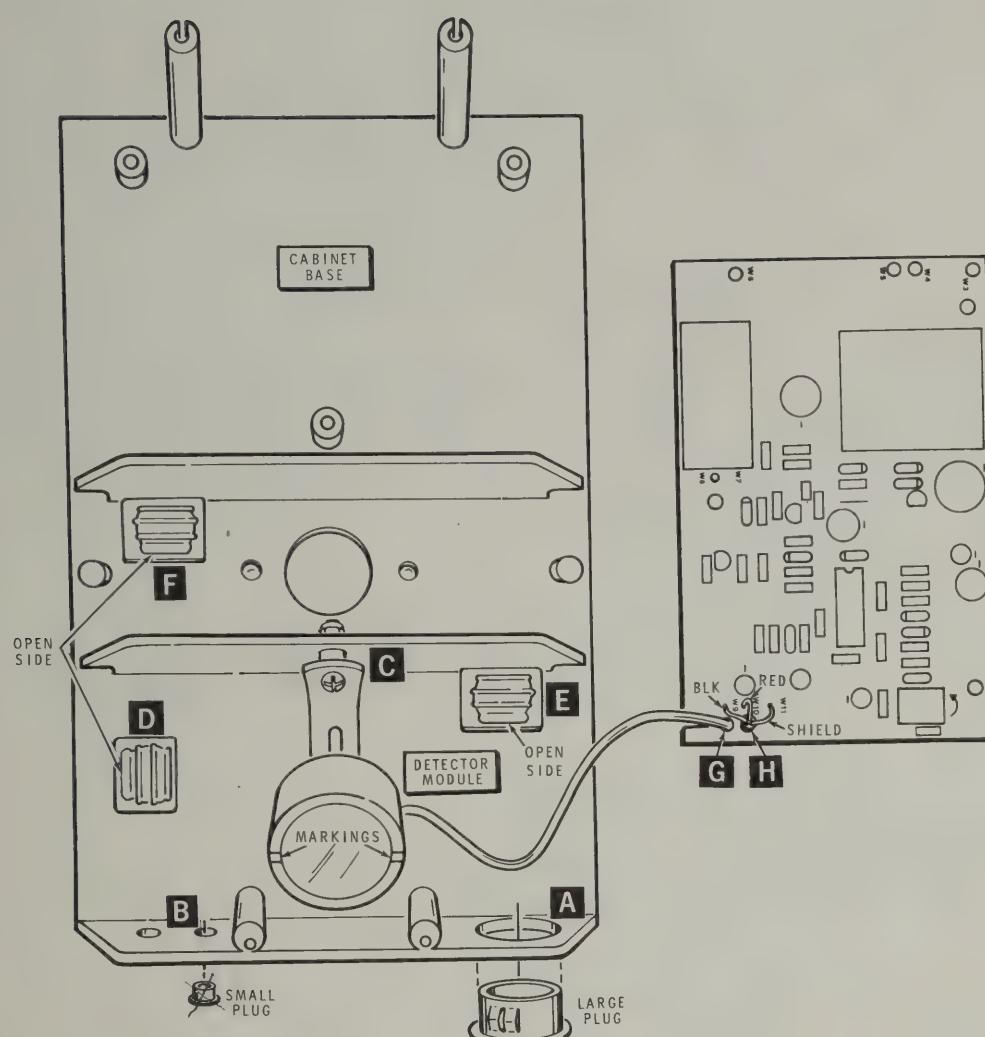


ILLUSTRATION BOOKLET

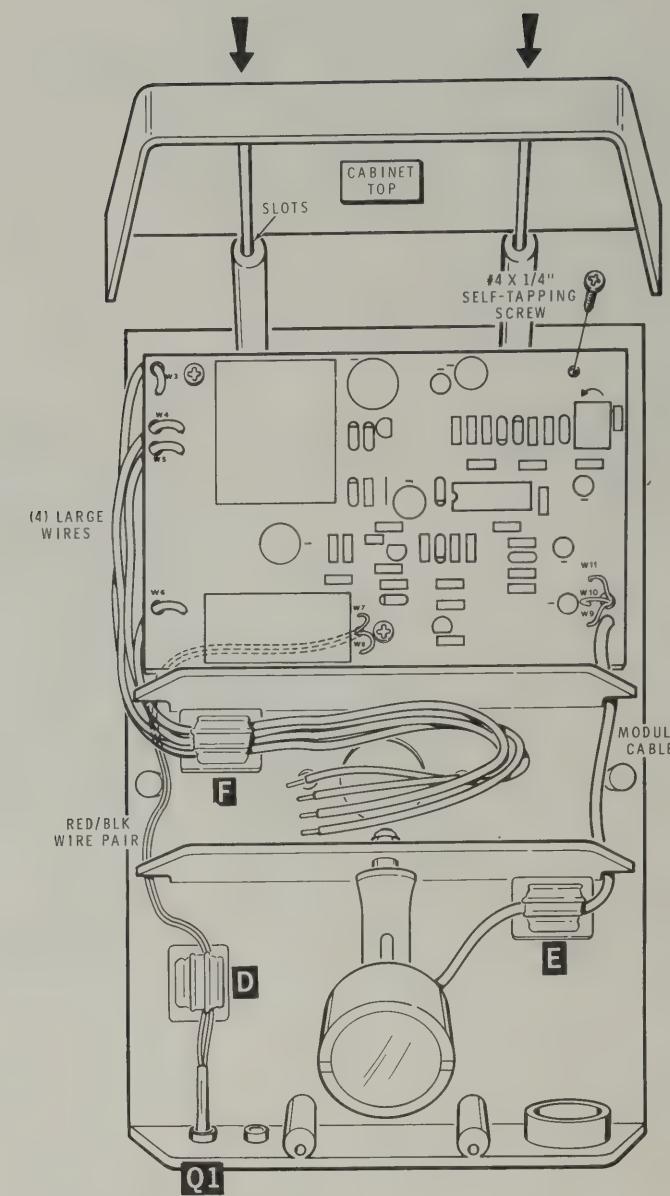
Part of 595-2453

PARTS PICTORIAL

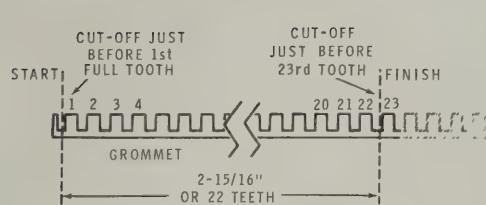




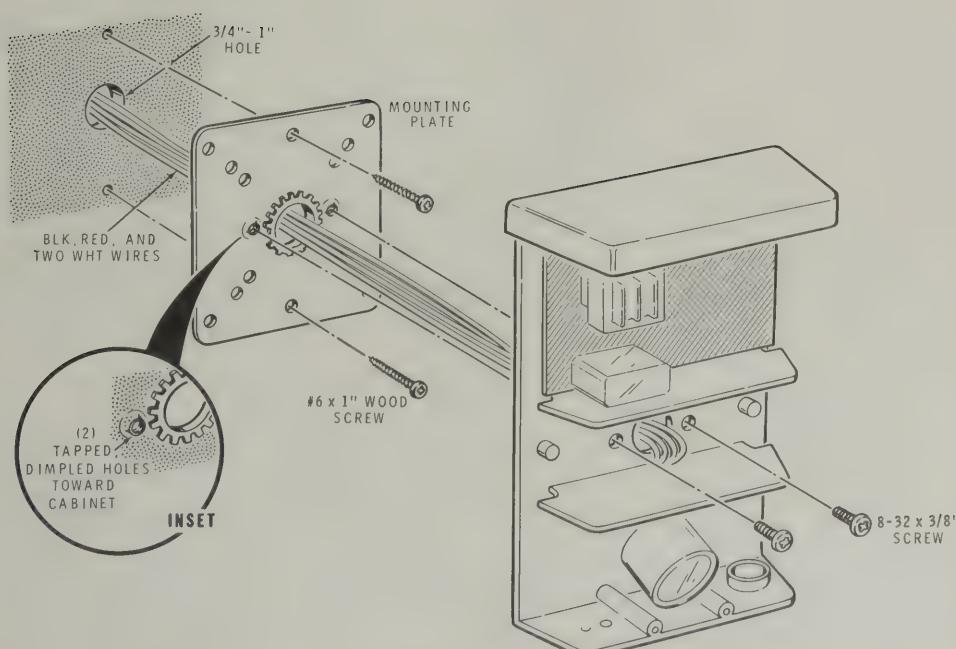
PICTORIAL 2-1



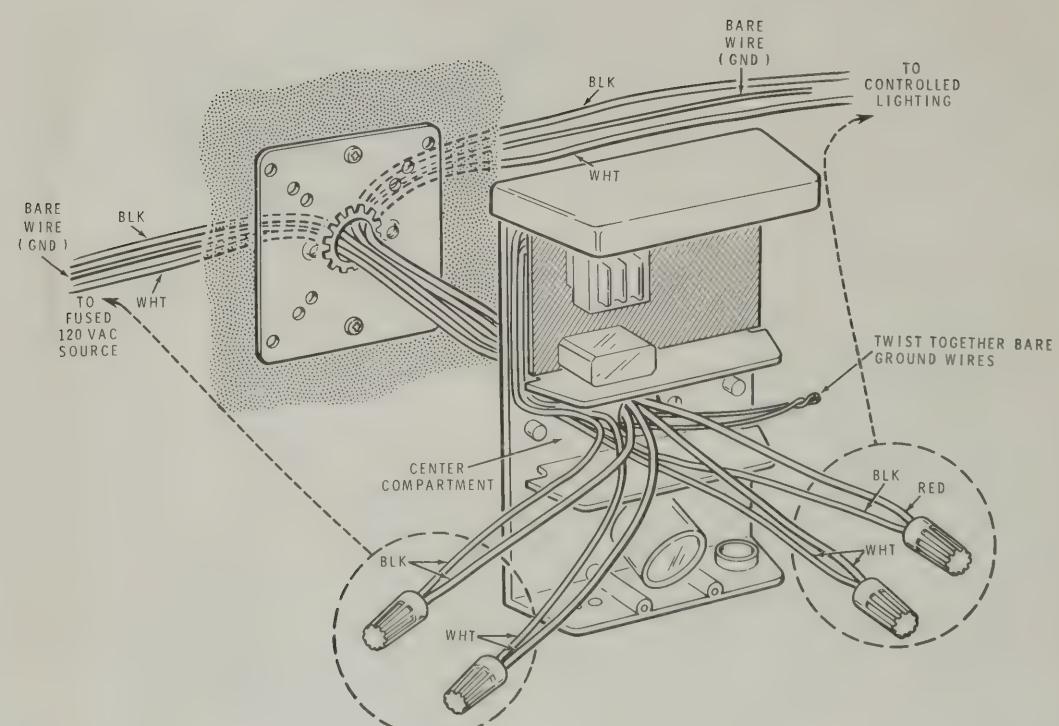
PICTORIAL 2-2



Detail 4-4A



PICTORIAL 4-4



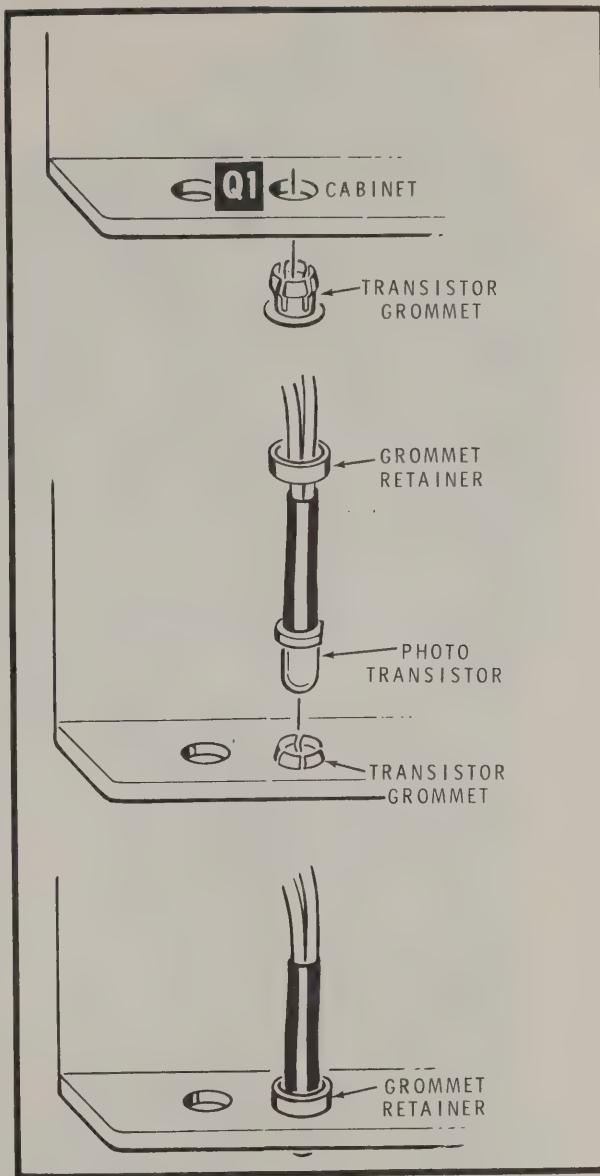
PICTORIAL 4-5

WARNING: 120-VAC CIRCUITS ARE POTENTIALLY LETHAL. THESE SHOULD BE HANDLED ONLY BY QUALIFIED OR LICENSED ELECTRICIANS. CHECK YOUR LOCAL BUILDING CODES.

THIS PICTORIAL IS INTENDED TO SHOW THE NECESSARY WIRE CONNECTIONS ONLY; IT IS NOT NECESSARILY INTENDED TO REPRESENT YOUR SPECIFIC REQUIREMENTS OTHERWISE.

Refer to Detail 2-2B for the next three steps.

- (1) 1. Push the transistor grommet upward into the cabinet hole at Q1.
- (2) 2. Slide the grommet retainer upward onto the photo transistor wires. Then push the photo transistor all the way down into the transistor grommet.
- (3) 3. Slide the grommet retainer down the wires and push it firmly onto the outside of the grommet as shown.
- (4) Push the small red/blk wire pair into wire clip D, and snap the clip closed.
- (5) Slide the cabinet top onto the cabinet, making sure it is pushed all the way to the bottom of its slots as shown in Pictorial 2-2.
- (6) Route the four heavy wires at the left side of the circuit board around the top center partition and into the center compartment as shown. Secure the black and red wires into wire clip F. The free ends of these wires will be connected later.
- (7) Route the two heavy white wires across the top of wire clip F. Then refer to the inset drawing on Pictorial 2-2 and secure the white wires to the red and black wires where they emerge from the wire clip. Pull the cable tie tight around the wires and cut off the excess tie end.



Detail 2-2B

ILLUSTRATION BOOKLET

Page 2 — On Pictorial 2-1, cross out the small plug shown at hole B. The plug will not be used.

— Cut the new Pictorial 2-2 from this Notice and tape it over Pictorial 2-2 in the Illustration Booklet.

IMPORTANT NOTE: On Illustration Booklet Page 3, in Pictorials 2-3 and 3-1, the photo transistor and the heavy wires in the center compartment will be slightly different than shown. For the differences, see Pictorial 2-2.

ASSEMBLY MANUAL

Page 19 — Turn this Notice over and tape the new Page 19 over Page 19 in your Assembly Manual.

Thank you,

HEATH COMPANY

PICTORIAL 4-1

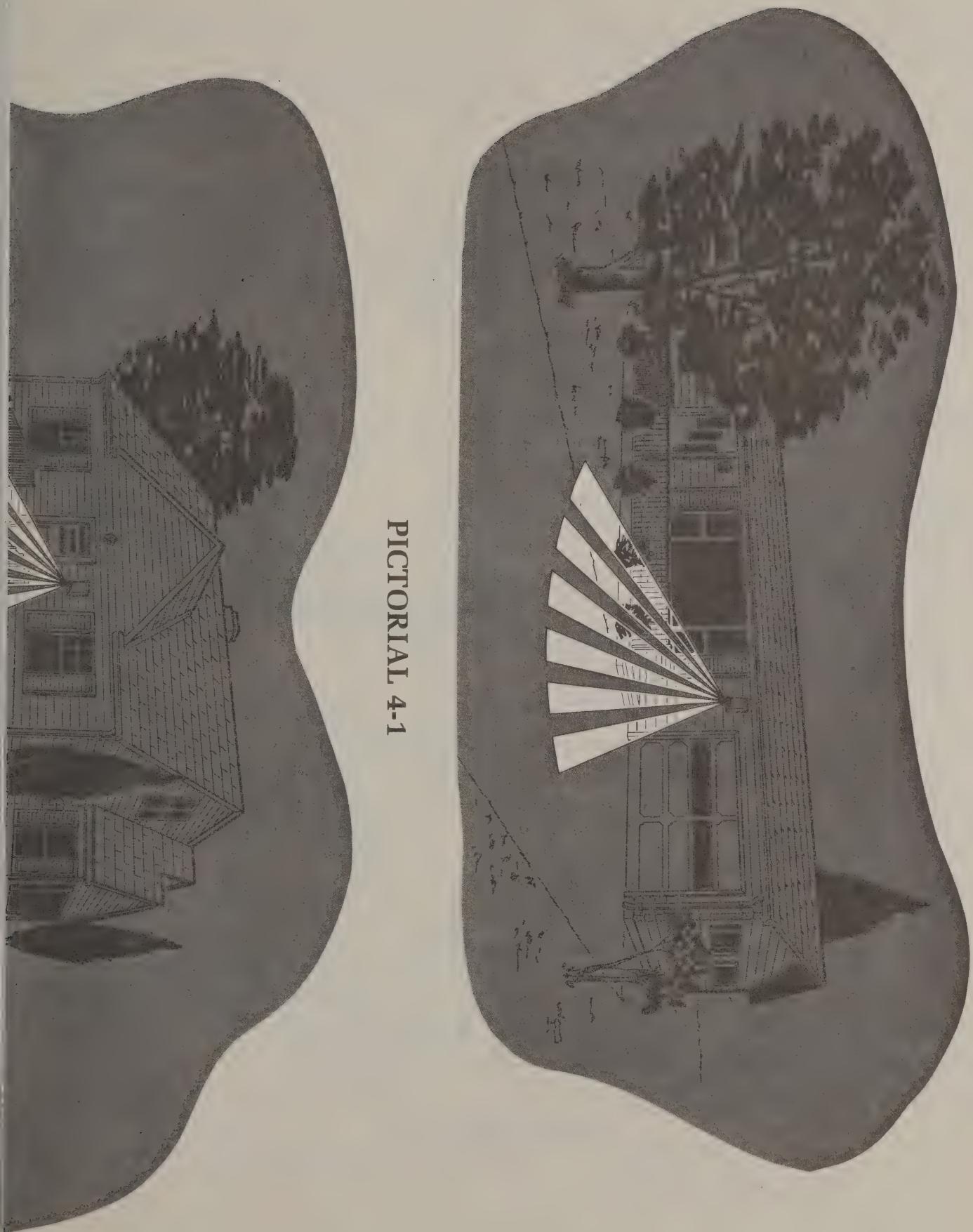


ILLUSTRATION BOOKLET

Page 2 — On Pictorial 2-1, cross out the small plug shown at hole B. The plug will not be used.

— Cut the new Pictorial 2-2 from this Notice and tape it over Pictorial 2-2 in the Illustration Booklet.

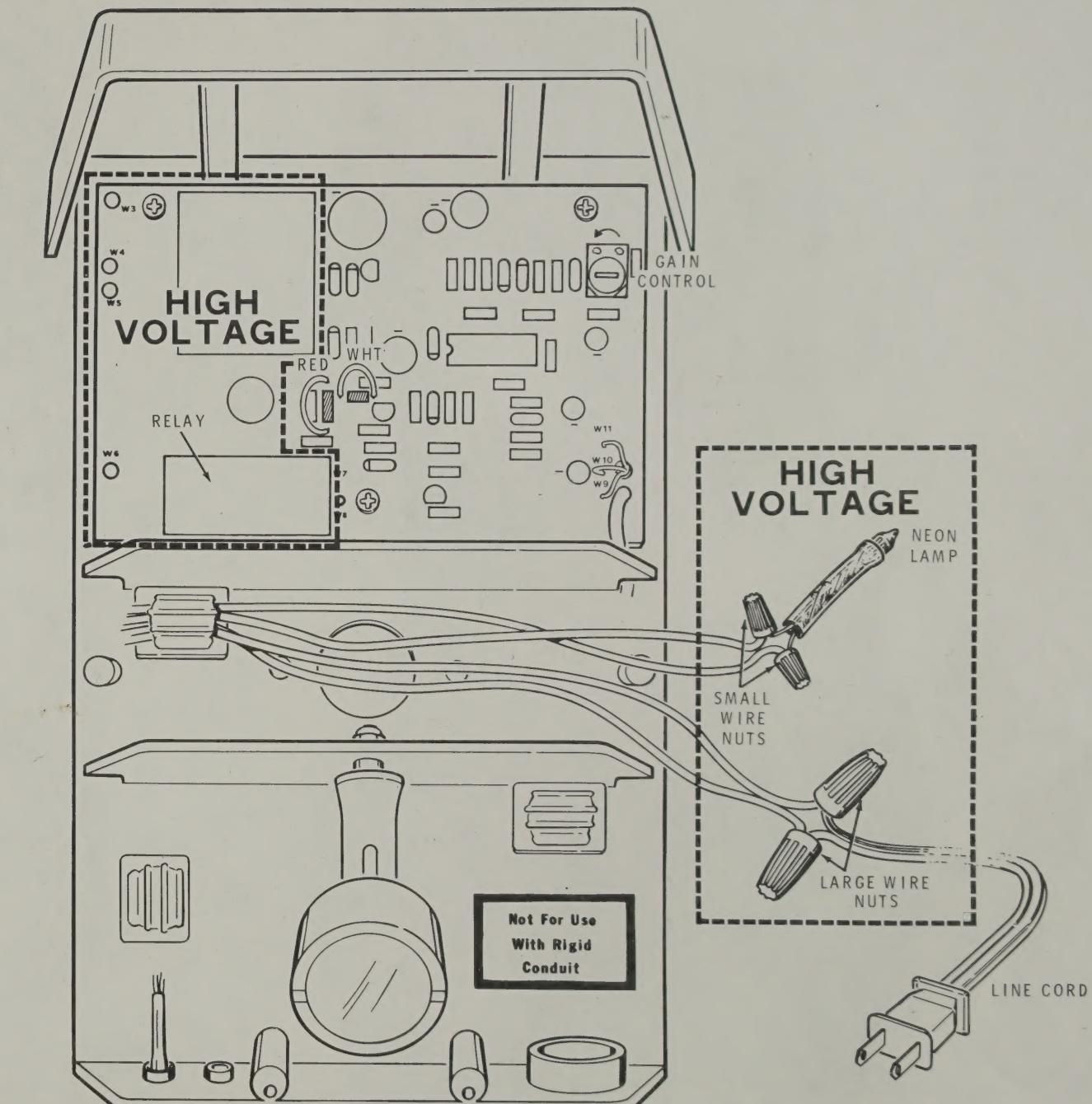
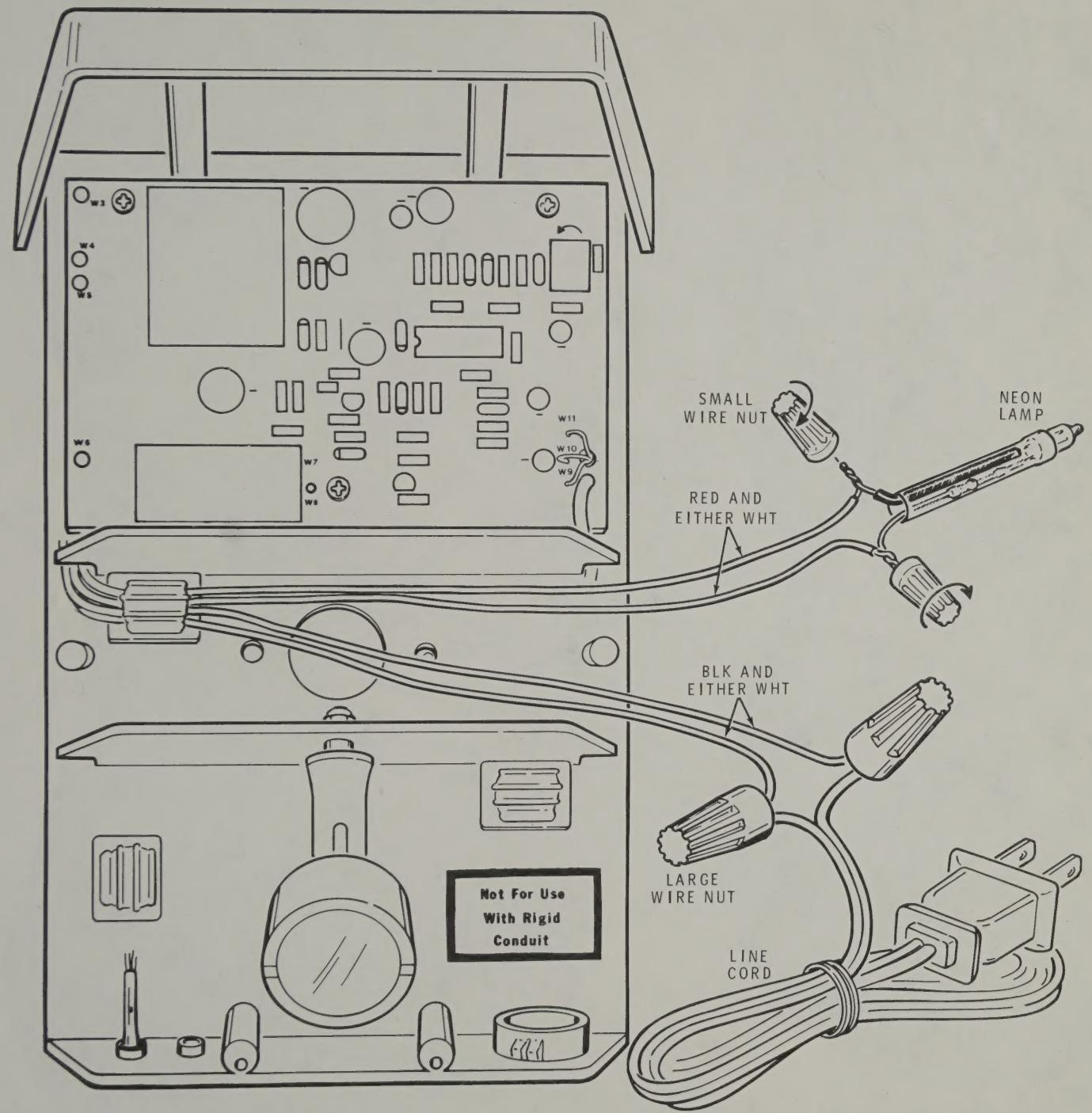
IMPORTANT NOTE: On Illustration Booklet Page 3, in Pictorials 2-3 and 3-1, the photo transistor and the heavy wires in the center compartment will be slightly different than shown. For the differences, see Pictorial 2-2.

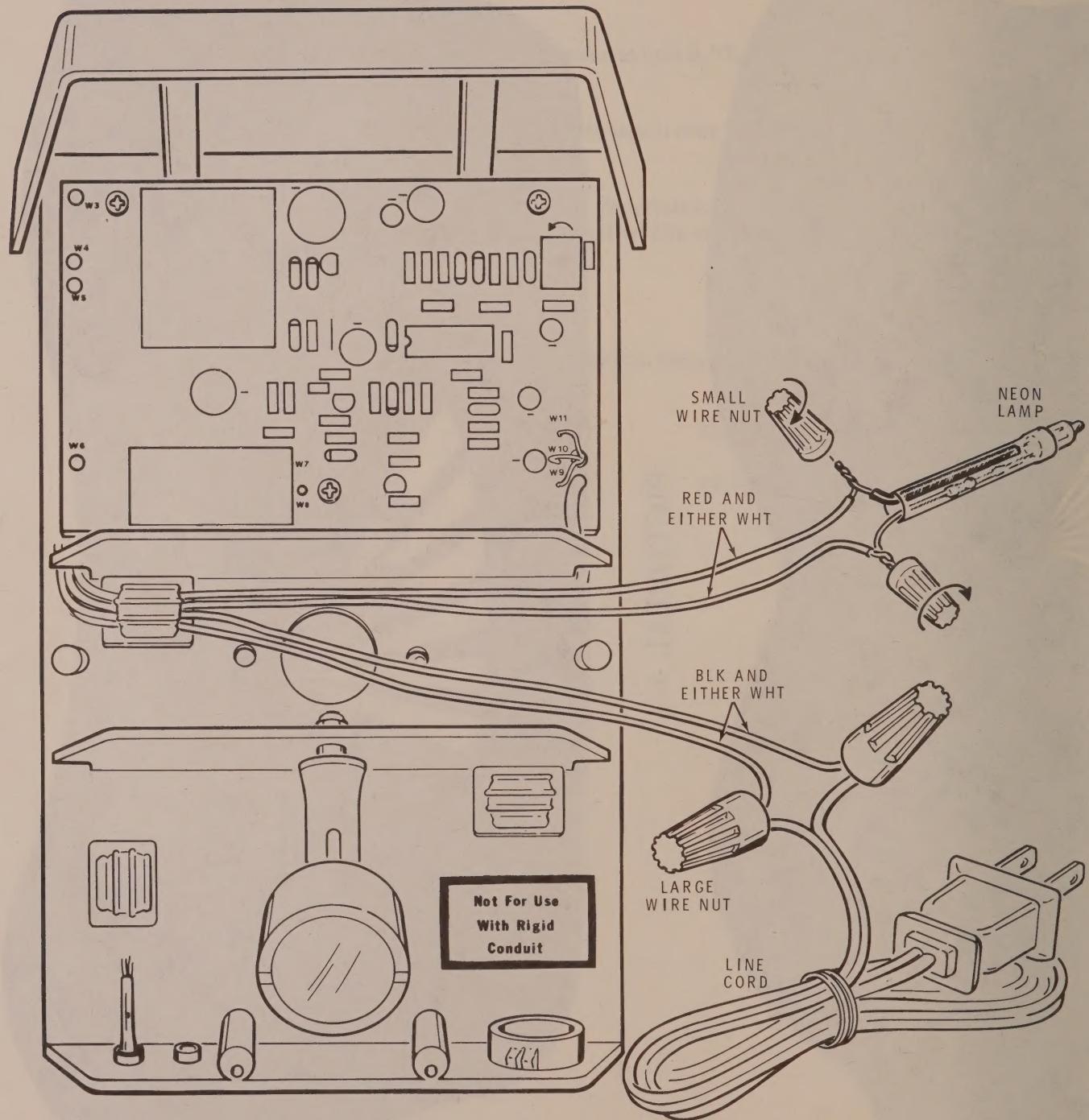
ASSEMBLY MANUAL

Page 19 — Turn this Notice over and tape the new Page 19 over Page 19 in your Assembly Manual.

Thank you,

HEATH COMPANY





PICTORIAL 2-3

CUSTOMER SERVICE

REPLACEMENT PARTS

Please provide complete information when you request replacements from either the factory or Heath Electronic Centers. Be certain to include the **HEATH** part number exactly as it appears in the parts list.

ORDERING FROM THE FACTORY

Print all of the information requested on the parts order form furnished with this product and mail it to Heath. For telephone orders (parts only) dial 616 982-3571. If you are unable to locate an order form, write us a letter or card including:

- Heath part number.
- Model number.
- Date of purchase.
- Location purchased or invoice number.
- Nature of the defect.
- Your payment or authorization for COD shipment of parts not covered by warranty.

Mail letters to: Heath Company
Benton Harbor
MI 49022
Attn: Parts Replacement

Retain original parts until you receive replacements. Parts that should be returned to the factory will be listed on your packing slip.

OBTAINING REPLACEMENTS FROM HEATH ELECTRONIC CENTERS

For your convenience, "over the counter" replacement parts are available from the Heath Electronic Centers listed in your catalog. Be sure to bring in the original part and purchase invoice when you request a warranty replacement from a Heath Electronic Center.

TECHNICAL CONSULTATION

Need help with your kit? — Self-Service? — Construction? — Operation? — Call or write for assistance. You'll find our Technical Consultants eager to help with just about any technical problem except "customizing" for unique applications.

The effectiveness of our consultation service depends on the information you furnish. Be sure to tell us:

- The Model number and Series number from the blue and white label.
- The date of purchase.
- An exact description of the difficulty.
- Everything you have done in attempting to correct the problem.

Also include switch positions, connections to other units, operating procedures, voltage readings, and any other information you think might be helpful.

Please do not send parts for testing, unless this is specifically requested by our Consultants.

Hints: Telephone traffic is lightest at midweek — please be sure your Manual and notes are on hand when you call.

Heathkit Electronic Center facilities are also available for telephone or "walk-in" personal assistance.

REPAIR SERVICE

Service facilities are available, if they are needed, to repair your completed kit. (Kits that have been modified, soldered with paste flux or acid core solder, cannot be accepted for repair.)

If it is convenient, personally deliver your kit to a Heathkit Electronic Center. For warranty parts replacement, supply a copy of the invoice or sales slip.

If you prefer to ship your kit to the factory, attach a letter containing the following information directly to the unit:

- Your name and address.
- Date of purchase and invoice number.
- Copies of all correspondence relevant to the service of the kit.
- A brief description of the difficulty.
- Authorization to return your kit COD for the service and shipping charges. (This will reduce the possibility of delay.)

Check the equipment to see that all screws and parts are secured. (Do not include any wooden cabinets or color television picture tubes, as these are easily damaged in shipment. Do not include the kit Manual.) Place the equipment in a strong carton with at least THREE INCHES of *resilient* packing material (shredded paper, excelsior, etc.) on all sides. Use additional packing material where there are protrusions (control sticks, large knobs, etc.). If the unit weighs over 15 lbs., place this carton in another one with 3/4" of packing material between the two.

Seal the carton with reinforced gummed tape, tie it with a strong cord, and mark it "Fragile" on at least two sides. Remember, the carrier will not accept liability for shipping damage if the unit is insufficiently packed. Ship by prepaid express, United Parcel Service, or insured Parcel Post to:

Heath Company
Service Department
Benton Harbor, Michigan 49022



HEATH COMPANY • BENTON HARBOR, MICHIGAN
THE WORLD'S FINEST ELECTRONIC EQUIPMENT IN KIT FORM